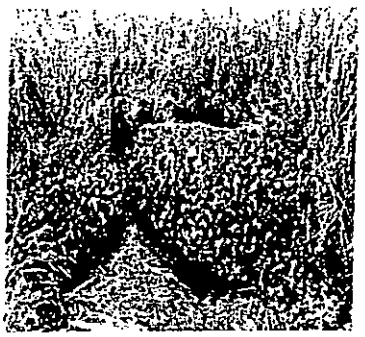
THE REPUBLIC OF UGANDA
MINISTRY OF WATER AND ENVIRONMENT

LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROJECT II (PREPARATION)



CONSULTANCY SERVICE ON APPLIED RESEARCH PROGRAMME FOR THE LAKE VICTORIA BASIN

FINAL REPORT

BY

THE DEPARTMENT OF ZOOLOGY, MAKERERE UNIVERSITY

P.O. BOX 7062, KAMPALA (UGANDA)

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LIST OF ABBREVIATIONS AND ACRONYMS

ARP	Applied Research Programme
BMUs	Beach Management Units
CBOs	Community Based Organizations
DDT	Dichlorodiphenyltrichloroethane
DEH	Department of Environmental Health
DWD	Directorate of Water Development
EAC	East African Community
ECOSAN	Ecological Sanitation Toilets
FAO	Food and Agricultural Organization
FGDs	Focus Group Discussions
FIRRI	Fisheries Resources Research Institute
FRD	Fisheries Resources Department
FTI	Fisheries Training Institute
GAL	Government Analytical Laboratory
GIS	Geographical Information System
gw-sw	Ground water-Surface water interactions
HIMS	Health Information Management System
IBAs	Important Bird Areas
IK	Indigenous Knowledge
IPM	Integrated Pest Management
IUCN	World Conservation Union
LFA	Logical Framework Analysis
LVB	Lake Victoria Basin
LVBC	Lake Victoria Basin Commission
LVDP	Lake Victoria Development Programme
LVEMP	Lake Victoria Environmental Management Project
LVFO	Lake Victoria Fisheries Organization
LVWQM	Lake Victoria Water Quality Model
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
Mak	Makerere University
MISR	University Institute of Social Research
MoH	Ministry of Health
MoTTI	Ministry of Tourism, Trade and Industry
MOV	Means of Verification
MUIENR	Makerere University Institute of Environment and Natural Resources
MWE	Ministry of Water and Environment
MWLE	Ministry of Water, Lands and Environment
NAADS	National Agricultural Advisory and Development Services
NAFIRRI	National Fisheries Resources Research Institute
NARO	National Agricultural Research Organization
NEMA	National Environmental Management Authority
NFA	National Forestry Authority
NGOs	Non Governmental Organizations
NR	Natural Resources
NWSC	Water and Sewerage Corporation
OVI	Objectively Verifiable Indicator
PARIs,	Public Agricultural Research Institutes

PCBs	Polychlorinated Biphenyls
PMA	Plan for Modernization of Agriculture
QA	Quality Assurance
QC	Quality Control
RAs	Research Areas
SAP	Strategic Action Plan
TDA	Trans-boundary Diagnostic Analysis
TORs	Terms of References
UBOS	Uganda Bureau of Standards
UEGCL	Uganda Electricity Generation Company Limited
UIA	Uganda Investment Authority
UWA	Uganda Wildlife Authority
VicRes	Lake Victoria Research
WID	Wetlands Inspection Division
WRMD	Water Resources Management Department

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EXECUTIVE SUMMARY

This document highlights the Key Applied Research Thematic areas identified by stakeholders of LVEMP. Nine themes were identified namely: Capture fisheries and aquaculture, Water quality and quantity, Atmospheric deposition, Catchments management, Aquatic weeds, Socio-economic and private sector, Biodiversity, Trans-boundary Issues and Data and database management. The document also assesses and proposes institutional framework, budget and implementation plan for ARP.

The document arises out of a consultancy awarded to the Department of Zoology, Makerere University, and covers three main phases: Inception, mid term and draft final, each with specific outputs. The overall output is a prioritized Applied Research programme based on gaps identified in consultation with stakeholders. A three pronged approach was employed involving extensive literature review, field consultations with a wide range of stakeholders (including beneficiary communities and institutions from LVEMP 1), working sessions and workshops. National Workshops were held in which key stakeholder views were sought and incorporated in the document (see Appendix VII).

Why Applied Research? While LVEMP1 generated baseline data, the information was not packaged in a ready to use format for purposes of replication or scaling up to address the management and conservation of Lake basin resources. Secondly, the basic research did not cover all researchable areas, and therefore gaps need to be filled. Applied Research is defined in this document as a research process that generates outputs and outcomes that may be readily used for the management, conservation and development of the livelihoods of the lake basin communities.

The document is divided into 6 chapters and the main issues covered are discussed below:

i. The first chapter covers the background information on Lake Victoria basin and the TOR.
ii. The second chapter deals with the methods for gathering information, and how the proposed Applied Research areas were prioritized.

iii. The third chapter summaries the key issues identified from literature and field consultations. It specifically lists of issues for each thematic area: contributing factors, known trends, effects and researchable areas. Appendix VI provides information on the main basis for prioritization of issues, development of the proposed projects and logical frame work.

iv. Chapter 4 covers the proposed Applied Research Programme under the nine thematic areas with 18 result areas (sub-thematic research areas):

The Applied Research programme has been budgeted to cost US $ 11 million, over a 5 year implementation period. However, the proposed ARP has a total estimated budget of USD 10,420,245, leaving a balance of USD 579,755 which is intended to cover fluctuations in exchange rates. In addition, there are might be as yet unknown changes in costs of materials and consumables. Allocation of funds is indicated in Appendix VIII.

Thematic Area 1: Capture Fisheries and aquaculture. This has three result areas, namely Enhancing fish catches and biodiversity, Reduction of fish post harvest losses and Development of Economically Viable Aquaculture in the Lake Victoria Basin. The proposed budget for this thematic area is USD 1,848,000.

Thematic Area 2: Water quality and quantity has four result areas: Appropriate Waste and Wastewater Treatment Technologies, Low-Cost Home-Based Water Treatment Technology and Sanitation Improvement, Water Quality and Quantity Modelling in Lake Victoria Basin, and Sedimentation in Lake Victoria. The proposed budget is USD 2,302,500.

Thematic Area 3: Atmospheric deposition of nutrients has only one result area, to establish the Effects of Atmospheric pollutant depositions on the Lake Ecosystem. The proposed budget is USD 512,000.

Thematic area 4: Catchment management covering two result areas: The River Bukora Integrated Watershed Management and the Effects of Inappropriate Handling and Use of Agrochemicals on the Environment and Public Health. The proposed budget is USD 1,719,000.

Thematic area 5: An aquatic weed also has two result areas: Sustainable control of water hyacinth and other invasive weeds, and effective national early warning mechanism for management of water hyacinth and other invasive water weeds. The proposed budget is USD 460,000.

Thematic Area 6: Socio-economics and private development has two result areas, namely Generating options for boosting environmental health and community development, and Generating options for enhancing private-public-community partnerships for sustainable natural resources based development. The proposed budget is USD 1,217,000.

Thematic area 7: Biodiversity has one result area, namely: Enhanced Biodiversity of the Lake and its Catchment. The proposed budget is USD 603,000.

Thematic area 8: Trans-boundary management of common issues covers two result areas: Promoting collaborative natural resources management and harmonization of key cross border policies, and Promote Effective Environmental Governance through Institutional Collaboration and Harmonization of Laws and Policies. The proposed budget is USD 577,000.

Thematic Area 9: Data and Database Management has one result area namely, improved data collection, processing, storage and management. The proposed budget is USD 1,181,745.

i. Chapter five has the proposed monitoring programme under LVEMP II, specifying the key parameters and proposed implementing institutions. The monitoring programme is to be implemented by the Monitoring and Evaluation Component of LVEMP2.
ii. Chapter Six covers the proposed implementation framework for the applied research programme, with a detailed institutional framework.

CHAPTER ONE

1 Background

Lake Victoria is Africa's largest and the world's second largest freshwater lake. It is one of the most important shared natural resources of Eastern Africa. Lake Victoria straddles across the common borders of the three East African Community Partner States of Kenya, Tanzania and Uganda. The lake features the world's largest freshwater fishery with significant local consumption and exports, in particular to the European Union. Furthermore Lake Victoria is also a global centre of aquatic biodiversity. The lake basin is valued for its socioeconomic potential in addition to immense ecological values. The economic potential of the catchment is based on rich agricultural soils, abundant rainfall, and significant mineral deposits, among others. The lake, on the other hand, is one of the unifying factors for the three Partner States of the East African Community, in addition to having a critical importance to the region's society and economy as a source of food, potable water, transportation, water for agricultural, power generation and tourism.

The lakeshore population is the most rapidly growing in all the three countries; it has one of the highest population growth rates in the world (3-6% annually). In addition, the lake basin has potential for economic growth in the three countries where poverty alleviation is among the regions' priorities.

The lake has experienced a decline in water quality since the 1960s. Phosphorus concentrations and algal biomass have increased significantly, and filamentous and colonial algae now dominate the algal community. Water hyacinth invaded the lake, and in the mid- to late 1990s: this led to reduced the efficiency of operation of the Owen Falls hydroelectric dam. Floating mat of water hyacinth blocked access to ports, fish landings, and watering points. Other changes have occurred in the fisheries sector; the originally multi-species fishery has reverted to one dominated by three species, two of which were introduced.

The concept of joint management of the Lake Victoria and its Basin, as a shared ecosystem, gained momentum following the conclusion of the Rio Earth Summit in 1992. It was for this reason that The Lake Victoria Environmental Management Project (LVEMP) was prepared and implemented from 1994 to 2005. Further developments led to the inauguration of the Lake Victoria Development Programme (LVDP) at the EAC Secretariat in 2001 and more recently to the development of a protocol for sustainable management of Lake Victoria Basin (LVB) which provides both for the detailed legal framework and the Lake Victoria Commission as a body for the regional management of the entire basin.

LVEMP 1 and other bilateral efforts have generated significant knowledge and developed technical capacity in the national agencies of the three countries to enable, among other things, the assessment of the environmental stresses confronting the lake and its catchment. Additional research on key issues, for example on atmospheric pollution, is needed. This research will form the basis for prioritizing actions and set objectives for improved management of the lake and its resources. This should be done in a participatory manner involving key stakeholders such as the local community and

ensuring that the interests and concerns of these stakeholders are appropriately reflected.

In many cases, final objective setting will require agreement of the other riparian states and the endorsement by the EAC through its Secretariat. The successful setting of objectives for water quality management requires a broad vision of what the riparian peoples' desire for Lake Victoria in the future. This will require blending individual sector knowledge and visions for their resources with the more general and integrative interests of the communities that enjoy and require beneficial uses of the lake and its tributary waters.

Implementation of the LVEMP-1 has resulted in improved ability in the riparian states to embark on a long-term program of resource management and environmental improvement (such as capacity building). Some of the achievements of LVEMP I include:

i. Establishing and supporting fisheries "co-management units" with local fishing beach communities in over 800 communities around Lake Victoria;
ii. Obtaining an estimated 80-90 percent reduction in surface coverage of water hyacinth in the lake through central and village-level biological agent rearing and mechanical/manual means, thus reducing water hyacinth to non-nuisance levels except in some hotspots including inflow from the Kagera River
iii. Undertaking a "whole lake" fishing pressure survey;
iv. Undertaking a harmonized "whole Lake" water quality/limnology survey
v. Undertaking three multi-sectoral management pilots projects (one in each country) of important micro-catchments in Lake Victoria Basin. These involved the soil conservation, catchment afforestation, wetlands management, micro-projects, and water quality components of the project working together to improve river/lake water quality; and
vi. Assisting the three East African governments to meet European Union requirements to improve beach sanitation and export certification of fish shipped to European Markets.

In spite of these interventions, some aspects of the lake's environment have become worse. Amongst these are: the declining lake levels attributed to several causes including the prolonged droughts in the recent years; declining fish catches, eutrophication and the resurgence of the water hyacinth. In addition other native aquatic weeds are becoming more invasive.

As a result of the establishment of East African Community and subsequent materialization of an East African Development Strategy (2001-2005) which designated LVB a regional economic growth zone, the identification of Lake Victoria Environmental Management Project Phase Two (LVEMP – 2) was done through a process involving a review of the performance of LVEMP 1 and the development of Vision and Strategy Framework for management and development of Lake Victoria Basin. The above processes culminated into a Regional Stakeholders Concept Workshop, which was held in Arusha in November 2005. This workshop identified the priority areas of focus for LVEMP – II as:

i. Socio-economic Development
ii. Management
iii. Applied Research

The next step in the preparation of LVEMP- II was to develop interventions that can use the information and capacity developed during LVEMP I to promote environmentally and socially sustainable economic development. For this purpose 9 consultancies were formulated by the East African Community to prepare various programmes and activities for LVEMP-II. One of the nine, the Applied Research Programme (ARP) has been prepared by the Department of Zoology, Makerere University to generate relevant environmental, social, and economic related findings and outcomes for application by the private and public sector in achieving the Development Objectives of the Basin.

1.1 Objectives of the Consultancy

The **main objective** of the consultancy is to identify key activities for developing an Applied Research Programme in natural resources, environment, trans-boundary issues, socio-economic and private sectors.

1.1.1 Specific Objectives of the Consultancy

The specific objectives as stated in the Terms of Reference (TOR), Appendix 1 are:

i. To summarize environmental, social and economic-related findings and outcomes for application by the riparian communities, public and private sectors.
ii. To identify gaps in the applied research agenda.
iii. To prepare a detailed research proposal on atmospheric deposition with emphasis on phosphorus.
iv. To prepare a prioritized and costed applied research programme to be implemented at both national and regional level.

CHAPTER TWO

2 METHODS AND MATERIALS

2.1 Introduction

The tasks leading to the Mid-Term Report were carried out in close collaboration with the client. The methods used to gather information for the report included the following:

i. Desk literature reviews of LVEMP I and other relevant documents. These included the National and Regional TDA reports, LVEMP I Lessons Learned Reports and Synthesis Reports (Fisheries and Water Quality/Quantity), LVEMP I Implementation Completion Report, Kagera River Basin Integrated Water Resources Management Project, Mara River Basin Integrated Water Resources Management Project. Other documents reviewed included the Sio, Malaba-Malakisi River Integrated Water Resources Management Project and SAP. Some of the key documents consulted are presented in Appendix IX.

ii. Field Visits. During field visits, the Consultant undertook the following activities:
   a. Interviews with relevant stakeholders.
   b. Used semi-structured questionnaires for obtaining relevant information from the stake holders.
   c. Focused Group Discussions (FGDs) with stake holders
   d. Interviewed Key Informants in the LVB.

Key stakeholders that were consulted are listed in Appendix V *A, B & C.*

iii. Surveys
   a. Direct observation on issues especially where non-response is expected to some extent and on issues which are difficult to explain by stakeholders.

iv. Institutional mapping to identify who is best-suited to undertake the responsibility of implementing different aspects the ARP.

v. Held working sessions and workshops

The Consultant liaised with the Client to organize a National Workshop to get inputs from all relevant stakeholders that was held in Jinja in December 2006. This document therefore is a revised version of the draft Mid Term Report and has incorporated comments from the stakeholders. This Report was used as a basis for preparing the Draft Final Report presented at a workshop at Mukono.

The Draft Final Report has been used to prepare the Final Report using a Logical Framework Analysis, with components well defined in terms of overall goal, purpose, result areas, activities, indicators and a budget. The report further provides information on assessing and proposing target research capacity building and a detailed research proposal on atmospheric deposition especially on phosphorus into Lake Victoria.

2.2 Quality Assurance and Quality Control

The Consultant undertook the following measures to achieve Quality Assurance (QA) and Quality Control (QC): The following steps were taken:

i. The Consultancy was headed by Dr. F.J. Muyodi, who worked with a Core Committee drawn from the Consultancy Team to address QA and QC. The Core Committee took the lead responsibility to ensure compliance to high quality standard outputs. The Consultancy Team is presented in Appendix IV.
ii. The Consultant was regularly debriefed by the Client in order to address key issues.
iii. Regular liaison meetings with the other National Consultants engaged by LVEMP. In addition, the Consultant liaised with other Consultants from the Partner States to solicit for their inputs.
iv. Regular meetings with relevant stakeholders (e.g. Reviewers; Key Government Ministries and Departments; NGOs/CBOs and the Private Sector).

2.3 Risks / Constraints and Mitigation Measures

The following are some of the constraints faced by the Consultant:

i. Cutting of the Time Framework for Consultancy from 9 to 4 months, putting immense pressure on the team members. The Consultant therefore had to engage more personnel.
ii. The Lake Victoria Basin is very large with multiple stakeholders, so it was very difficult to reach and consult all of them. The Consultant thus used different approaches such as field visits and focused group discussions to reach a wide section of the communities in the LVB.
iii. Delayed disbursement of funds that has hampered the work of the Consultancy. The Consultant used limited but well qualified personnel and resources.
iv. Consultations with Consultants from Partner States created additional time constraints. The consultant used amongst others, E-mail services to reduce on costs of communication.

2.4 Criteria Used for Prioritizing the Proposed ARP

Seven categories of criteria of issues were identified and used in prioritizing the proposed ARP (Table 1). These issues were identified on the basis of the TORs, as they reflected and addressed key environmental, economic, social, public and private concerns of the Lake Victoria Basin. A pair-wise comparison was used to rank sub sections of each criterion. Subsequently, a weighted score for each criterion was calculated as presented in Appendix VI.

Table 1. Criteria for the prioritization of the proposed ARP

S.No.	Criteria	Weight
1.	Address key society concerns – 7 a. Gender - 5 b. Food security – 2.5 c. Household income - 10 d. Health – 7.5	25
2.	Contribute to improving environmental quality – 6 a. pollution control – 8.4 b. sanitation improvement – 2.2 c. wetlands conservation - 6.2 d. Biodiversity conservation – 4.2	21
3.	Addresses economic development – 5 a. Private sector involvement - 6 b. Benefits communities - 9 c. Public sector involvement – 3	18
4.	Addresses widespread concerns – 4 a. Community involvement – 9.4 b. Public concern – 4.6	14
5.	Scalable, appropriate and good practices – 3 a. Cost – 2.2 b. Capacity (Infrastructure and Human) – 1.1 c. Effectiveness – 4.4 d. Demand-driven – 3.3	11
6.	Addresses trans-boundary issues – 2 a. Addresses policy – 1.2 b. Addresses management – 2.3 c. Harmonization – 3.5	7
7.	Little is known about the issue – 1 a. Addresses a key gap – 1.3 b. Identified by stakeholders – 2.7	4

CHAPTER THREE

3 KEY RESEARCH FINDINGS AND GAPS

The Research Findings have been summarized as presented Appendix III. The research findings also took into considerations past interventions in the Lake Victoria Basin by various projects including LVEMP I (Appendix II). It is from these findings that the Researchable Areas and gaps were identified. These RAs are very many, multi-sectoral and complex in nature. They cannot therefore all be covered in the proposed ARP over the five year period. We have therefore identified the following broad themes:

i. Capture Fisheries and Aquaculture
ii. Water Quality and Quantity
iii. Atmospheric Deposition of Nutrients
iv. Catchments Management
v. Aquatic Weeds
vi. Socio-Economic and Private Sector Development
vii. Biodiversity
viii. Management of Trans-Boundary Issues
ix. Data and Database Management

For each theme, key issues were identified using the method described in Section 2.1. From each key issue, researchable areas/gaps were developed as shown in Appendix III. It is these researchable gaps/areas that were prioritized for each of the seven themes using criteria and methods given in Section 2.4.

CHAPTER FOUR

4.1 PROPOSED APPLIED RESEARCH PROGRAMME

The projects presented in this chapter are under the following 9 broad thematic areas: Capture Fisheries and Aquaculture; Water Quality and Quantity; Atmospheric Deposition of Nutrients; Catchments Management; Aquatic Weeds; Socio-Economic and Private Sector Development; Biodiversity; Management of Trans-Boundary Issues; Data and Database Management.

4.1.1 THEMATIC AREA 1. CAPTURE FISHERIES AND AQUACULTURE

Result area 1.1. Enhancing fish catches and biodiversity

Introduction

Fish catch per fisherman in Lake Victoria increased from about 3 tons per fisherman in 1970 to peak in 1980 to about 8 tons per fisherman. This dropped again to about 3 tons per fisherman per year in 2004 (Okaronon 2003, 2005; TDA 2006). The average size of fish caught and landed has also declined. The rise in catches in the 1980s was due largely to the entry of the Nile perch and slightly due to the new *Rastrineobola* fishery. The multi-species fishery is, accordingly, currently reduced to three main species, namely the introduced Nile perch (*Lates niloticus*) and Nile tilapia (*Oreochromis niloticus*) and the native cyprinid, Mukene (*Rastrineobola argentea*).

The major reasons for the drastic decline in fish diversity and fish stocks (and thus catches) in Lake Victoria has been attributed to over fishing; capture of immature fish; use of destructive fishing gears and methods (e.g. beach seines, trawl nets); sedimentation and pollution; degradation of fish habitat; hypoxia in the deeper zones of the lake; ignorance about location of critical habitats (e.g. breeding grounds, nursery beds fish refugia and biodiversity hot spots); and extensive draw down in lake level.

Continued decline in catch per unit of effort and average of the fish landed is a serious constraint that requires urgent resolution. The main purpose of the proposed Applied Research programme(s) is to increase the fish catches and the average size of landed catch.

Main objective 1.1.1. To devise mechanisms for effective control of use of illegal fishing gears and methods

Researchable issues

i. Assess the extent of the use of illegal fishing gears and methods.
ii. Assess the impact of different gillnet width (number of meshes) on fish stocks.
iii. Explore options for controlling the use of illegal fishing gears and methods.
iv. Evaluate the current institutional mechanisms and arrangements and propose ways of strengthening them.
v. Establish underlying social and economic factors that prevent adherence to policies, regulations and by-laws.
vi. Develop options for assessing the effectiveness of control mechanisms of illegal gears and methods on fish stock enhancement

Proposed methods

i. Participatory assessment of the extent and underlying causes of the use of illegal gears and methods.
ii. Evaluate the impact of different gillnet width on fish stocks
iii. Detailed study on the existing institutional capacity and readiness to enforce policies and regulations.
iv. Evaluate existing incentives/disincentives and propose alternatives where necessary.
v. Develop and pilot multi-stakeholder monitoring initiatives for fish stocks enhancement (e.g. increased catches and average size exploited).
vi. Any other methods to be proposed by the implementer

Expected outputs

i. Extent of use of illegal gears and methods established
ii. Impact of different gillnet width on fish stocks evaluated
iii. A list of underlying causes for the use of illegal gears and methods.
iv. Appropriate control mechanisms.
v. Underlying social, economic and institutional factors established.
vi. Institutional capacity mechanisms developed.
vii. Increased catches and average size of fish exploited

Beneficiaries

i. Fishers, traders and Fish processors
ii. Fisheries Resources Department
iii. Fisheries Research Institutes
iv. Ministry of Agriculture, Animal Resources and Fisheries
v. Lake Victoria Fisheries Organization (LVFO)
vi. Local Government
vii. Private Sector
viii. Other Researchers

Monitorable indicators

i. Participatory enforcement
ii. Impact of different gillnet width on fish stocks
iii. Mechanisms for control
iv. Institutional development mechanisms
v. Catch levels

Main objective 1.1.2. To generate information to inform the protection and enhancement of biodiversity for increased fish production

Researchable issues

i. Establish critical biodiversity hot spots (e.g. key fish breeding and nursery habitats as well as fish refugia) for protection.
ii. Assess and monitor the effects of lake level fluctuations on breeding and nursery of fish biodiversity (especially major commercial fish species).
iii. Explore mechanisms for enhancing fish stocks in the main lake.
iv. Develop mechanisms for sustainably managing fish stocks in the lake.
v. Develop options for protecting fish breeding grounds

Proposed methods

i. Mapping of critical biodiversity hot spots.
ii. Participatory (including IK) identification and mapping of fish breeding and nursery grounds and refugia.
iii. Mapping of zones of marked fluctuations of water level.
iv. Monitoring and collection of information on the effects of draw down on breeding, nursery and feeding grounds as well as refugia.
v. Pilot options for enhancing fish stocks in the main lake.
vi. Participatory piloting of options for protecting fish breeding grounds.
vii. Collect and update information on fish stocks.
viii. Conduct a trends analysis on stocks
ix. Any other methods to be proposed by the implementer

Expected outputs

i. A map of biodiversity hot spots developed.
ii. Data linking water levels to biodiversity.
iii. Options for enhancing fish stocks in the main lake developed.
iv. Piloted options for protecting fish breeding grounds in place.
v. Mechanisms for sustainable fish stocks

Beneficiaries

i. Fishers, traders and Fish processors
ii. Fisheries Resources Department
iii. Fisheries Research Institutes
iv. Ministry of Agriculture, Animal Resources and Fisheries
v. Lake Victoria Fisheries Organization (LVFO)
vi. Local Government
vii. Private Sector
viii. Other Researchers

Monitorable indicators

i. Map
ii. Data on water levels and biodiversity
iii. List of options
iv. Updated data on fish stocks

Other identified main objectives in Capture fisheries include

i. Strategies for Strengthening the Management of Capture Fisheries
ii. Generate information for improving and promoting fishing technologies
iii. Generate information to inform the restocking and management of satellite lakes

Result Area 1.2. Reduction of fish post harvest losses

Introduction

Fish post harvest losses within the Lake Victoria basin are estimated at between 20% and 40%, depending on the species and the season. The reasons for the losses include long duration in water after capture, poor hygiene and sanitary facilities at the landing sites, limited use of ice for preservation during transportation, and inadequate

processing technologies. Applied Research will seek to identify the underlying causes of fish post harvest losses and devise appropriate ways of minimizing them.

Main objective 1.2.1: Developing technologies and practices for reduction of fish post harvest losses among artisan fisher folks

Researchable issues

i. Establish the extent and underlying causes of post harvest losses
ii. Enhance low-cost technologies and capacity to process and preserve fish
iii. Explore options for obtaining credit facilities for artisan fisher folks
iv. Explore mechanisms for developing infrastructure for fish handling, transportation, processing and marketing
v. Improve hygiene and sanitation at the landing sites

Proposed methods

i. Participatory investigation into post harvest losses
ii. Identify existing low-cost technologies
iii. Participatory investigation into adoption rates of appropriate low-cost technologies
iv. Build capacity for using the new technologies
v. Multi-stakeholder scaling up of appropriate low-cost technologies
vi. Participatory identification of options for obtaining credit facilities for artisan fisher folks
vii. Participatory development of improved hygiene and sanitation at the landing sites
viii. Any other methods to be proposed by the implementer

Expected outputs

i. Underlying causes of post harvest losses identified
ii. Existing low-cost technologies identified
iii. Adoption rates of appropriate low-cost technologies established
iv. Capacity for using the new technologies built
v. Appropriate low-cost technologies scaled up
vi. Options for obtaining credit facilities for artisan fisher folks developed
vii. Improved hygiene and sanitation at the landing sites

Beneficiaries

i. Fishers, traders and Fish processors
ii. Fisheries Resources Department
iii. Fisheries Research Institutes
iv. Ministry of Agriculture, Animal Resources and Fisheries
v. Lake Victoria Fisheries Organization (LVFO)
vi. Local Government
vii. Private Sector
viii. Other Researchers

Monitorable indicators

i. Post harvest losses
ii. Low-cost technologies
iii. Adoption rates
iv. Capacity
v. Options

vi. Hygiene and sanitation

Result Area 1.3. Development of Economically Viable Aquaculture in the Lake Victoria Basin

Introduction

Appropriate Aquaculture Technologies for fisheries development have been done in Uganda since 1950s. However, this has so far not met the desired impact in the sector. The need for the development of commercial aquaculture arose because of the reducing supply of fish from "capture fisheries" and also the need for more income and more availability of fish food for the people in the basin. There has been several initiatives but these have been ineffective for lack of information to guide stocking of ponds and restocking of minor or satellite lakes; poor pond management practices; inadequate supply of appropriate and high quality seeds, and limited variety of cultured species.
The proposed AR programme therefore aims at research that will increase and sustain fish production so that there is increased earning and the fish protein.

Main objective 1.3.1. To improve aquaculture management practices

Researchable issues

i. Compile, package and disseminate information on available technologies on pond siting, construction, stocking, and management of appropriate fish species for culturing
ii. Explore options for funding to up-scale aquaculture

Proposed methods

i. Participatory study of the past and present aquaculture practices in the basin and propose areas for improvement
ii. Desk study of existing information and packaging
iii. Workshops, mass media, pamphlets for information dissemination
iv. Pilot management options
v. Donors'/strategic partners consultative meeting
vi. Any other methods to be proposed by the implementer

Expected outputs

i. A range of appropriate aquaculture technologies and practices reviewed
ii. Publications on aquaculture technologies and practices
iii. Potential financiers/ strategic partners for aquaculture identified

Beneficiaries

i. Fish farmers
ii. Public sector
iii. Private sector
iv. NGO, CBO, and local Government officials
v. FRD/MAAIF, NAFIRRI, FTI,
vi. Department of Zoology – Makerere Univ.,
vii. MUIENR, PARIs,
viii. Local Government

Monitorable indicators

i. Information packages (media records)
ii. A range of aquaculture technologies and practices
iii. A list of financiers/ strategic partners

Main Objective 1.3.2. Increase the Production of Improved and Better Quality Seed of Different Culture Species (Improving the Quality and Diversity of Aquaculture Options)

Researchable issues

i. Evaluate the quality of existing aquaculture fish seed
ii. Examine the use of low-cost technologies in production of high value and good quality aquaculture fish seeds
iii. Develop options for adopting new culture species

Proposed methods

i. Research into low cost breeding and production of high value aquaculture fish
ii. Participatory consumer selection of fish species to be cultured
iii. Evaluate the suitability of various species for culturing
iv. Pilot new culture species
v. Scale up proven technologies and practices
vi. Any other methods to be proposed by the implementer

Expected outputs

i. Information on the quality of existing seed
ii. High quality value seeds adopted
iii. Low-cost technologies adopted
iv. Options for adopting new culture species developed

Beneficiaries

i. Fish farmers and seed producers
ii. Public sector
iii. Private sector
iv. NGOs, CBOs, FRD, NAFIRRI, local Government officials
v. Universities

Monitorable indicators

i. Technologies
ii. Seeds
iii. A list of options

Main objective 1.3.3. To improve on the quality and cost-effectiveness of fish feeds developed from local and exotic ingredients

Researchable issues

i. Evaluate existing fish feeds and establish quality appropriate for optimum fish growth.
ii. Develop and pilot fish feeds for the various fish species.
iii. Promote the use of local ingredients in the production of fish feeds

Proposed methods

i. On-farm survey on users perception of the different existing feeds
ii. Laboratory tests to establish ingredients and quality
iii. Participatory consumer selection of fish feeds
iv. Participatory piloting of fish feeds
v. Any other methods to be proposed by the implementer

Expected outputs

i. Information on feeds for different fish species and age groups available
ii. Consumer preferences established

Beneficiaries

i. Fish farmers, feed sellers and producers.
ii. Private and public sectors.
iii. NAFIRRI/ Kajjansi center, FRD.
iv. NGOs, CBOs
v. Local Government.

Monitorable indicators

i. Fish feeds

Main objective 1.3.4. To establish the viability of culturing Nile perch

Researchable issues

i. Establish the optimum environmental conditions for the Nile perch fry survival and growth
ii. Assess suitable food items for cultured Nile perch
iii. Formulate and evaluate feeds for optimum growth
iv. Establish the optimum marketable size of cultured Nile perch
v. Evaluate the cost-effectiveness and market of cultured Nile perch

Proposed methods

i. Conduct trials to establish optimum conditions for Nile perch survival and growth
ii. Evaluate the growth of Nile perch fed on various feeds
iii. Any other methods to be proposed by the implementer

Expected outputs

i. Optimum environmental conditions established
ii. Suitable food items identified
iii. Feeds for optimum growth formulated and evaluated
iv. Optimum marketable size established
v. Cost-effectiveness and market evaluated

Beneficiaries

i. MAAIF, NAFIRRI/NARO, NAADS
ii. Universities
iii. Private Sector
iv. Fish Farmers
v. Local Government, NGOs, CBOs

Monitorable indicators

i. Environmental conditions
ii. Nile perch feeds
iii. Marketable size
iv. Profitability of Nile perch culture

Main objective 1.3.5. To establish the feasibility of cage culture in the Lake Victoria Basin

Researchable Issues

i. Establish environmental conditions for cage culture
ii. Evaluate the suitability and profitability of different species for cage culture
iii. Assess suitable feeds for cage culture
iv. Establish suitability of different sites and cages
v. Establish an environmental monitoring programme
vi. Assess the acceptability of cage culture
vii. Study fish diseases associated with cage culture
viii. Propose institutional and legal framework for cage culture

Proposed methods

i. Evaluate ongoing trials to establish optimum conditions for cage culture
ii. Evaluate the growth of different species under cage culture
iii. Develop suitable feeds for cage culture
iv. Design and evaluate appropriate cages and siting for different species
v. Develop and implement an environmental monitoring program
vi. Conduct a participatory evaluation of acceptability of cage culture
vii. Develop institutional and legal framework for cage culture
viii. Identify fish diseases under cage culture and develop preventive measures
ix. Pilot cage culture
x. Any other methods to be proposed by the implementer

Expected outputs

i. Optimum conditions established
ii. Growth of different species evaluated
iii. Suitable feeds developed
iv. Appropriate cages designed and sites identified
v. Environmental monitoring program developed and initiated
vi. Acceptability of cage culture established
vii. Institutional and legal framework developed
viii. Fish diseases under cage culture identified
ix. Preventive measures developed
x. Cage culture piloted

Beneficiaries

i. Partner states
ii. MAAIF, NAFFIRRI/NARO, NAADS,
iii. Universities, Other researchers,
iv. Private Sectors, Financiers
v. NGOs, CBOs, Local Governments

Monitorable indicators

i. Conditions for cage culture
ii. Growth of different fish species
iii. Feeds
iv. Cages and sites
v. Environmental monitoring programme
vi. Acceptability
vii. Institutional and legal framework
viii. Fish diseases
ix. Preventive measures
x. Pilot of cage culture

4.1.2 THEMATIC AREA 2. WATER QUALITY AND QUANTITY

Result Area 2.1. Appropriate Waste and Wastewater Treatment Technologies

Introduction

Increased human population and rapid urbanization within the Lake Victoria basin has resulted in increased discharge of industrial and municipal effluents (which in most cases are not treated before discharge) and urban run-off. This invariably poses a bigger problem to the lake ecosystem, which is the recipient of much of the effluents (Kansiime *et al.* 1995). Municipal waste and industrial effluents are of particular concern to water quality in the lake, which receives the treated and untreated effluents. The lake is also the source of water supply for urban centres such as Kampala. With increased socio-economic development and pollution loads, there is concern that the bays could soon become unsuitable as raw water sources.

One noted intervention was by LVEMP1 through the Management of Industrial and Municipal Effluents and Urban Run-off Component. It was implemented by the National Water and Sewerage Corporation (NWSC) and the Tertiary Municipal Effluents Pilot Project was one of its sub-components. One of the major achievements was the Kirinya pilot study which was conducted on the use of natural and constructed wetlands in treatment of municipal and industrial effluents. The output of the pilot project was rated among the most successful projects of LVEMP 1 (Implementation Completion Report LVEMP1, 2006). This can therefore be scaled up and applied in the Murchison Bay wetlands.

Another way of addressing this issue is through multi-institutional and private sector collaboration. For this purpose, the linkage between the private sector, NWSC, WRMD, researchers and other stakeholders is important in developing appropriate waste treatment and management technologies.

This project is aimed at addressing waste water treatment through scaling up the Kirinya pilot project and developing collaboration amongst key stakeholders.

Main objective 2.1.1. To Scale up the Successful Kirinya Waste Treatment Project and Develop Technologies for use in the Collaborative Treatment of Wastes

Researchable issues

i. Evaluate the Kirinya Tertiary Municipal Effluent Treatment Pilot Project in the Murchison Bay and Namiiro wetlands
ii. Assess options for scaling up the treatment pilot project
iii. Explore options for effective multi-stakeholder waste (wastewater, solid waste and gas emissions) treatment technologies
iv. Build capacity to recycle / reuse waste products by key stakeholders
v. Promote generation of useful by-products (such as biogas and manure) and positive attitudes towards their use
vi. Develop strategies for technology transfer

Proposed methods

i. Increase the contact surface area and retention time of the Murchison Bay (Port Bell) and Namiiro wetland (Entebbe) through bio-manipulation within the wetland before discharge into the lake
ii. Rehabilitate NWSC oxidation ponds in Murchison bay and Namiiro in Entebbe
iii. Pilot and scale up the Kirinya Tertiary Municipal Effluent Treatment Pilot Project in the Murchison Bay and Namiiro wetlands
iv. Hold relevant stakeholders' sensitization seminars for attitude change
v. Develop and pilot options for re-use and recycling waste by-products
vi. Develop and pilot options for stakeholders' acceptance of the new wastes treatment technologies
vii. Selection of relevant stakeholders and sites for piloting wastes treatment technologies
viii. Train and develop infrastructure of stakeholders
ix. Any other methods to be proposed by the implementer

Expected Outputs

i. The Kirinya Tertiary Municipal Effluent Treatment Pilot Project scaled up
ii. Effective multi-stakeholder waste treatment technologies developed
iii. Capacity to recycle / reuse waste products developed
iv. Useful by-products and positive attitudes developed
v. Strategies for technology transfer developed

Beneficiaries

i. NWSC
ii. Water Resources Management Department, DWD
iii. Industries producing wastes
iv. Communities that utilize catchment resources
v. Researchers
vi. Private sector in general

Monitorable indicators

i. Treatment plants
ii. Treatment technologies
iii. Capacity

iv. Attitude change
v. Strategies

Result Area 2.2. Low-Cost Home-Based Water Treatment Technology and Sanitation Improvement

Introduction

Contractions of waterborne diseases (such as cholera, diarrhoea and dysentery) occur after exposure to and consumption of pathogenic microorganisms from contaminated water sources. Every year, millions of the world's poorest people die from preventable diseases caused by inadequate water supply and sanitation services, and women and children are the main victims. Many people in the catchment districts draw water from water sources contaminated with coliform bacteria such as *Escherichia coli.*

For example, in Rakai district water coverage is 42.6%; however in some areas it is as low as 5%. Koki County is semi-arid and is also a cattle corridor area with no surface water but with the potential for ground water abstraction.

The districts also face problems of inadequate sanitary facilities. The main problems observed in urban areas are waste management, inadequate toilet and sanitary facilities and unplanned settlements. For example, in some places in Rakai district, up to 10 households share a single toilet. Kasensero landing site has a population of about 40,000 people excluding children and has only two public toilets. Many people in Kasensero ease themselves in polythene bags and throw their feacal wastes onto roof-tops. The high water table and sandy nature of the land in the area renders construction of pit latrine very difficult.

Nsumba village is a model in sanitary and hygienic practices in Rakai district. The village illustrates clearly how communities can be innovative in using local resources in order to lower incidences of contracting water-related diseases and generally improve their health conditions.

Main Objective 2.2.1 Develop technologies for purifying water and to improve house-hold sanitation

Researchable issues

i. Assess the quantity and quality of water supplied to selected communities.
ii. Examine and recommend important alternative sources of water to the communities.
iii. Improve sanitary conditions and reduce waterborne disease prevalence in the selected communities.
iv. Evaluate cheap innovative measures to prevent waterborne diseases.
v. Assess the suitability of Moringa (*Moringa oleifera* Lam) and other cheaper alternatives to purify water at the household level.
vi. Examine the Nsumba model village sanitary and hygienic practices.
vii. Reduce poverty through improved hygiene.

Proposed methods

i. Guided interviews and questionnaires with local communities in the selected areas.

ii. Obtain information from key informants such as Local Councils, Health Inspectors and local government officials on the status of access to water and sanitary facilities.
iii. Conduct transect walks while making observations
iv. Collect and analyze water samples for establishing its quality
v. Estimate quantity of water used within households
vi. Test the use of ultra-violet rays to purify water (solar purification).
vii. Experiments on Moringa (*Moringa oleifera* Lam) and other cheaper materials to purify water
viii. Scale up Nsumba model village sanitary and hygienic practices.
ix. Design a pilot sanitary facility based on good hygienic practices eg. Latrines with hand-washing facilities.
x. Any other methods to be proposed by the implementer

Expected outputs

i. Quality and quantity of water improved.
ii. Alternative sources of water examined
iii. Sanitary conditions improved
iv. Incidences of water-related diseases reduced
v. Cheap innovations to prevent waterborne diseases developed
vi. Suitability of Moringa (*Moringa oleifera* Lam) and other cheaper alternatives to purify water tested
vii. Access to clean drinking water improved
viii. Nsumba model village sanitary and hygienic practices scaled up
ix. Poverty reduced through improved hygiene
x. Proposed interventions accepted.

Beneficiaries

i. Communities
ii. Local governments
iii. Department of Environment Health (MoH)
iv. Researchers
v. Private water developers

Monitorable indicators

i. Water quality and quantity
ii. Alternative sources of water
iii. Prevalence of water-related diseases
iv. Innovations to prevent waterborne diseases
v. Alternatives to purify water.
vi. Sanitary and hygienic practices
vii. Poverty

Result Area 2.3. Water Quality and Quantity Modelling in Lake Victoria Basin

Introduction

There is deterioration of water quality and quantity of Lake Victoria. This is due to various causes such as pollution, habitat change and inappropriate land use practices amongst others. The result of these changes is deteriorating water quality for production; the declining water levels are affecting the fisheries, hydropower generation and others.

There have been a number of interventions including LVEMP. One of the interventions that is important is modelling. Models are predictive and therefore are good management and decision-aid tools.

The WQ component of LVEMP 1 looked at the effect of circulation of currents on pollutants in Lake Victoria and the development of a water quality model, which would assist administrators and managers in relevant government departments with main management options for environmental protection of the lake. The Lake Victoria Water Quality Model (LVWQM) was developed to simulate the physical processes and water quality in Lake Victoria. It was based on existing data which was insufficient to support full calibration or verification. Unfortunately, the LVWQM was non-functional by close of LVEMP 1 partly due to lack of trained manpower and funding for training in its use. Completing and operationalising the LVWQM will help to answer questions related to sustainable water resources management and policy implementation. However, the model should be coupled to the catchment to provide a wider scope for management and policy issues. This is because it is mainly the catchment activities which influence the quality of the lake.

The meteorology and hydrology of the lake also affect water quality / pollution. An estimate of the total water balance for the lake is necessary in order to establish the water budget of Lake Victoria basin. The estimates are required for: rainfall into, and evaporation from the lake-surface; discharges to the lake from all rivers and its catchments and discharge from Lake Victoria into the Victoria Nile as well as baseflow from groundwater into the lake and vice versa. Water balance modelling is one of the key factors in determining pollution loading and understanding the hydrologic regime of the lake for proper management of the lake and its catchments. Updating the Water Balance Model will help to answer questions related to lake water levels and discharges including groundwater – surface water interactions. It will also help in designing mitigation measures to salvage the deteriorating environmental integrity.

Main Objective 2.3.1. To complete and operationalize the Lake Victoria Water Quality Model (LVWQM)

Researchable issues

i. Generate additional data for operationalising the model
ii. Assess capacity (human and infrastructure) to run the model
iii. Calibrate and test the model
iv. Use the LVWQM to predict trends

Proposed methods

i. Collect data on catchment parameters (e.g. nutrients loadings, algal blooms, water weeds, agro-chemicals and public health chemicals, sedimentation and heavy metals)
ii. Build capacity through training and procurement of equipments
iii. Use the existing and new data to calibrate
iv. Pilot the model to predict trends
v. Any other methods to be proposed by the implementer

Expected outputs

i. Additional data generated
ii. Capacity developed

iii. Model calibrated and tested
iv. Model used to predict trends

Beneficiaries

i. Water Resources Management Department in DWD (MWE)
ii. NWSC
iii. MAAIF
iv. DEH (MoH)
v. Communities
vi. Local governments
vii. Researchers
viii. Fisheries and agriculture institutions
ix. Other Private sector

Monitorable indicators

i. Data
ii. Capacity
iii. Model
iv. Trends

Main objective 2.3.2. Update the Water Balance Model to predict changes in water quantity

Researchable issues

i. Establish new and utilize existing networks (where they exist) in the catchment for data collection on water quantity
ii. Evaluate the relationship between ground water fluctuations and lake levels
iii. Assess the contribution of groundwater to lake pollution
iv. Collect additional data (including baseflow) for use in updating the model
v. Build capacity
vi. Update the model to predict trends in water quantity (inflows and outflows)
vii. Analyze trends in the flow quantities, rainfall and evaporation in order to manage the lake basing on the dynamics of the regime.
viii. Evaluate the current Water Release Policy and propose a new one
ix. Develop a Water Discharge Support System.

Proposed methods

i. Build capacity to run the model through training and procurement of equipments
ii. Collect new data for the model on issues such as river discharges, rainfall, evaporation, outflow
iii. Develop a network for monitoring groundwater levels by constructing piezometers
iv. Sample and analyze groundwater for water quality parameters to establish contribution of groundwater to lake pollution.
v. Use isotopic methods to determine source and interactions of groundwater and surface water
vi. Input, analyze data and calibrate the model
vii. Pilot the model for predicting water quantity trends
viii. Participatory evaluation of the current Water Release Policy

ix. Identify parameters to be used in developing a Water Discharge Support System
x. Pilot Water Discharge Support System
xi. Any other methods to be proposed by the implementer

Expected Outputs

i. New networks established and old ones rehabilitated
ii. New data collected
iii. Groundwater/lake water interactions established
iv. Baseflow in relation to evapotranspiration established
v. Contribution of groundwater to lake pollution assessed
vi. Model updated and piloted
vii. Capacity built
viii. Trends in water quantity analyzed
ix. Water Release Policy evaluated
x. New Water Release Policy developed

Beneficiaries

i. Water Resources Management Department in DWD
ii. Ministry of Energy and Mineral Development
iii. NWSC
iv. Meteorological departments
v. Local governments
vi. Researchers
vii. Fisheries and agriculture institutions
viii. Hydropower generation industry
ix. Private sector

Monitorable indicators

i. Water gauging networks
ii. Data
iii. Capacity
iv. Water Balance Model
v. Water quantity trends
vi. Water Release Policy

Result Area 2.4 Sedimentation in Lake Victoria

Introduction

The major sources of sediment inputs into Lake Victoria include runoff from the catchment and loads from rivers as well as atmospheric deposition. The sediments carry with them untreated effluents, chemicals and untreated sewage. When the latter decomposes, there is increased sedimentation due to decomposition.

LVEMP 1 carried out studies on sediment accumulation rates in Lake Victoria cores that had been dated and obtained a range between 100 g m^{-2} y^{-1} to over 300 g m^{-2} y^{-1} as dry weight accumulation which would be comparable to rates of about 0.5 to 1 mm per year. These rates are comparable to or somewhat higher than those observed in other great lakes.

Although there is yet no evidence that the rate of accumulation of sediments in Lake Victoria have changed over the last few decades in response to eutrophication, the nutrient content of Lake Victoria sediments has changed over time with very significant changes over the last 50 years (Heck,1993). These changes in nutrient availability have caused changes in the algal communities, as large rapidly sinking diatoms of the genus *Aulacoseira* (formerly *Melosira*) have been replaced by the thinly silicified forms of slow sinking *Nitzschia* in Lake Victoria's accumulating sediments. This change in diatom community has been accompanied by the increase in cyanobactera taxa (*Anabaena, Cylindrospermopsis, Microcystis and Planktolyngbya*) that now dominate the algal biomass. LvEMP 1 recommended that to restore the lake to earlier ecological conditions of the past century it will be necessary to reduce phosphorus loading to rates that occurred at that time.

Bathymetric studies are an important guiding tool in fishing and navigation but they were hardly addressed in LVEMP 1.

The ARP on sedimentation aims at monitoring sediment fluxes into the lake as related to activities in the catchment including land use and impacts on the water quality and aquatic life as well as bathymetric studies.

Main Objective 2.4.1. To assess rates of sedimentation and siltation on Lake Victoria and to generate a bathymetric map

Researchable issues

i. Establish the number of littoral and pelagic stations required for monitoring the rates of siltation and sedimentation
ii. Generate baseline data on the rates of sedimentation and siltation
iii. Establish a monitoring programme
iv. Generate data on the chemistry of the sediments at different depths
v. Generate data to assess climatic changes
vi. Generate data to contribute to the bathymetric map of Lake Victoria

Proposed methods

i. Increase the number and operationalize the existing stations
ii. Participatory identification of sites for installation of new pelagic and littoral stations
iii. Assess the rate of sedimentation and siltation in the lake
iv. Determine rates of sedimentation and age of sediments from sediment cores
v. Analyse samples for nutrients (including biogenic silicon) and organic composition
vi. Determine climatic change from sediment cores and organic remains
vii. Use echo sounders and air-gun to establish the bathymetry of the lake
viii. Any other methods to be proposed by the implementer

Expected Outputs

i. Number of stations increased and operationalized
ii. Sites for installation of new pelagic and littoral stations identified through a participatory approach
iii. Rates of sedimentation and siltation assessed
iv. Sediments and organic remains dated and climatic changes determined
v. Sediments analysed for nutrients and organic composition

vi. Bathymetry of the lake established
vii. Any other methods to be proposed by the implementer

Beneficiaries

i. Water Resources Management Department, DWD
ii. NWSC
iii. Fisheries Institutions
iv. Private sector dealing in water transport
v. Communities in the catchment
vi. Researchers

Monitorable indicators

i. Stations
ii. Community participation
iii. Rates
iv. Data
v. Bathymetric map

4.1.3 THEMATIC AREA 3. ATMOSPHERIC DEPOSITION OF NUTRIENTS

Result Area 3.1. Establish the Effects of Atmospheric pollutant depositions on the Lake Ecosystem

Introduction

Lake Victoria is characterized by a large surface area, direct precipitation and strong winds. Dust in air converges on the lake presenting a major route for atmospheric depositions (wet and dry). Thus, atmospheric depositions are a significant and increasing source of plant nutrients, particularly phosphorus and nitrogen in their most available forms (The World Bank, 1996), to the lake which might accelerate eutrophication. Apparently, atmospheric depositions account for about 60% of the total P and over 80% of total N loading to the lake. Therefore, monitoring the sources of atmospheric P and N entering the lake and their mode of transport is crucial in averting eutrophication.

Main objective 3.1.1. To Update Data on Sources and Quantities of Atmospheric Pollutants Entering Lake Victoria and Come Up with Mitigation Measures to Avert the Associated Problems

Researchable issues

i. Assess the contribution of atmospheric pollutants (including nutrient depositions) on Lake Victoria.
ii. Determine the sources, quantities, and routes of atmospheric pollutants entering the lake.
iii. Determine necessary actions to control and address the impairment caused by atmospheric pollutant depositions

Proposed methods

i. Use and collect new data on atmospheric depositions in the basin.

ii. Set up a network of monitoring stations across the lake basin on an urban, peri urban, and countryside gradient and on the lake – with less expensive more accurate equipment (to assess the significance of atmospheric deposition to the lake and to monitor for particular chemicals of concern).
iii. Collect, analyze and monitor atmospheric pollutants in dry and wet depositions
iv. Develop quantitative estimates of atmospheric pollutant deposition loads through monitoring and measurements and identify their sources using isotopic marker methods
v. Conduct a comprehensive mass balance study on Lake Victoria to understand the inputs and outputs of contaminants from all sources, including atmospheric deposition
vi. Collect, analyze and monitor key socio-economic activities that contribute to atmospheric deposition
vii. Adopt cost-effective actions to control and mitigate the impairment caused by atmospheric pollutants.
viii. Propose trade-off measures so that the international community can be requested to pay compensation for the atmospheric pollution of Lake Victoria if it is established that the pollutants emanate from beyond the Eastern African Region.
ix. Any other methods to be proposed by the implementer

Expected outputs

i. Importance of atmospheric pollutants to the Lake Victoria ecosystem established.
ii. Sources, quantities, and routes of atmospheric pollutant depositions determined.
iii. Influence of socio-economic and environmental factors on atmospheric pollutant depositions established.
iv. Necessary actions to control and address the impairment caused by atmospheric pollutant depositions determined

Target beneficiaries

i. Water resource managers in the catchment
ii. Water quality managers.
iii. Fisheries Industry
iv. Natural resource managers in catchment.
v. Environmental conservationists.
vi. Ministry of Health
vii. Ministry of Labour, Gender, and Social Development

Monitorable Indicators

i. Data on the importance of atmospheric pollutants to the lake ecosystem
ii. Data on sources, routes and extent of atmospheric pollution
iii. Network of monitoring stations
iv. Cost-effective actions

4.1.4 THEMATIC AREA 4. CATCHMENTS MANAGEMENT

Result Area 4.1. The River Bukora Integrated Watershed Management

Introduction

In spite of the "rich" natural resource endowment, River Bukora catchment presents an extensively degraded area reflected in widespread loss of biodiversity and vegetation through deforestation, soil erosion, bush burning, overgrazing and encroachment on marginal lands. The main identified causes of degradation include extensive unsustainable farming practices (Isabirye, 2005; Majaliwa, 2004); encroachment on wetlands for cultivation, brick making, sand and clay extraction (LVEMP, 2005). Rehabilitation efforts are hampered by socio- economic factors such as land tenure, affordability, institutional and legal limitations, among others (EAC, 2006). This has resulted in reduced quality of livelihoods and increased poverty levels. This project seeks to develop and pilot integrated management practices for rangelands, cultivated farmlands and wetlands in the Bukora catchment to mitigate degradation effects.

Main Objective 4.1.1: Developing and promoting better and sustainable rangeland and forestry management strategies

Researchable issues

i. Determine the magnitude, effects and monetary value of rangeland and forest degradation
ii. Develop and upscale viable management options for rangelands and forests
iii. Build capacity and systems for multi-stakeholder management of rangeland and forestry resources

Proposed methods

i. Socio-economic studies to assess the extent, impact and replacement value of selected degraded hotspots in the catchment
ii. Participatory land resource assessment and land use planning
iii. Develop and pilot local institutional arrangement and legal frame work for management of rangelands and forests
iv. Multi-stakeholder pilots to mitigate degradation
v. Training, exchange visits, etc
vi. Any other methods to be proposed by the implementer

Expected Outputs

i. The extent and value of land degradation established
ii. Appropriate land use plans developed
iii. Management options developed and adopted
iv. Stakeholders trained

Beneficiaries

i. Local councils/governments
ii. NEMA
iii. MAAIF
iv. Local Communities
v. NAFIRI and other research institutions
vi. Relevant CBOs and NGOs

Monitorable indicators

i. Land use plans for selected hotspots of the catchment
ii. List of options for sustainable rangeland and forestry management
iii. A list of stakeholders trained
iv. Options adopted by stakeholders

Main Objective 4.1.2. Promoting improved management strategies for cultivated farmlands of River Bukora catchment

Researchable issues

i. Identify and upscale economically viable farming practices (building on LVEMP 1 and other pilot studies in the region) e.g. integrated soil fertility and water management, water harvesting, pest management, agro-forestry and crop livestock integration)
ii. Build capacity of farmers and service providers in support of improved farming practices
iii. Strengthen local institutions (e.g. local leaders, CBOs, women groups) for monitoring and enhancing adoption of improved farming practices

Proposed methods

i. Participatory review of existing farm practices
ii. Training, exposure, exchange visits and short courses
iii. Participatory piloting of viable farming practices
iv. Regular reflection and learning sessions with stakeholders
v. Any other methods to be proposed by the implementer

Expected Outputs

i. Improved farming practices adopted by key stakeholders
ii. Stakeholders trained
iii. Local institutions promoting adoption of improved farming practices

Beneficiaries

i. Local councils/government
ii. NEMA
iii. MAAIF
iv. Local Communities
v. NARO and other research institutions
vi. Relevant CBOs and NGOs

Monitorable indicators

i. A basket of economically viable options for improved farming practices
ii. List of stakeholders trained
iii. A list of stakeholders promoting adoption of improved farming practices

Main objective 4.1.3. Restoration of ecosystem functioning of selected wetlands in the River Bukora catchment

Researchable issues

i. Promotion of community participation in the management and restoration of selected wetlands in the catchment
ii. Generation of management options for enhancing biodiversity and buffering capacity of the selected wetlands;

Proposed methods

i. Mapping the distribution/use of the wetlands of River Bukora catchment and select key sites as pilot restoration schemes
ii. Participatory appraisal of community institutions, user groups, their interest and practices;
iii. Developing and piloting community action plans for the selected wetlands sites
iv. Collection of key ecological and socio-economic baseline data (biodiversity, water quality and quantity, pollution status, community benefits, existing governance mechanism)
v. Developing and piloting multi-stakeholder management options
vi. Regular reflection and learning sessions with stakeholders to feed into a participatory biodiversity and buffering capacity monitoring mechanism
vii. Any other methods to be proposed by the implementer

Expected Outputs

i. Map showing the general distribution of wetlands and pilots
ii. Mechanisms for Community participation in wetland management developed
iii. Participatory biodiversity and buffering capacity monitoring mechanisms developed
iv. Proven strategies for the restoration of wetlands promoted

Monitorable Indicators

i. Map
ii. Mechanisms for Community participation
iii. Strategies for the restoration of wetlands
iv. Biodiversity monitoring mechanisms

Beneficiaries

i. Local Government
ii. NEMA
iii. WID
iv. DWD
v. MAAIF
vi. NWSC
vii. Local Communities
viii. NAFIRI and other research institutions
ix. Relevant CBOs and NGOs

Main objective 4.1.4. Piloting mechanisms for monitoring to assess the effects of improved catchment management on siltation and sedimentation in the River Bukora system

Researchable issues

i. Assess the importance of siltation and sedimentation in the Bukora catchment (rivers and lakes)
ii. Develop and pilot mechanisms for monitoring siltation and sedimentation of water bodies in the catchment

Proposed methods

i. Assess existing data on siltation and sedimentation in the catchment
ii. Field-based baseline information generation
iii. Desk-based data analysis for establishing importance
iv. Participatory community based monitoring
v. Network with established technical institutions
vi. Select sites linked to main objectives and for monitoring
vii. Any other methods to be proposed by the implementer

Expected outputs

i. Importance of siltation and sedimentation established
ii. Community-based monitoring system developed
iii. A network of technical institutions established
iv. Effectiveness of improved catchment management on siltation and sedimentation established

Monitorable indicators

i. Community-based monitoring system
ii. A network of technical institutions
iii. Water quality and quantity trends

Result Area 4.2. The Effects of Inappropriate Handling and Use of Agrochemicals on the Environment and Public Health

Introduction

Utilization of agrochemicals in the Lake Victoria catchment of Uganda is steadily increasing. The increase has been attributed to trade liberalizations that were introduced in early 1990s, the Plan for Modernization of Agriculture (PMA) with a goal to commercialize agricultural enterprises (Mubiru et al., 2004), and the shift towards cultivation of pesticide-intensive floricultural and horticultural crops (Wejuli et al., 2001). However, the use of agrochemicals has to be done with precaution because improper use and handling may adversely affect the environment and the effects are quite catastrophic to human and livestock health, crops, and the environment in general (Mubiru et al., 2004). Records at FAO also indicate that over 20,000 tons of obsolete, toxic and persistent chemicals are in stock in Africa. Due to the high demand of pesticides by farmers, some of these pesticides are still on market and in use by farmers (Wejuli et al., 2001).

Due to the challenges regarding agrochemical use in the country which include safety and costs, among others, and the existence of a niche market for organic foods, there has been a steady growth of the Organic Movement. To support their production, farmers have developed homemade organic agrochemicals. However, the use of these homemade organic chemicals is still limited due to lack of scientific data on their efficacy and cost-effectiveness.

Accumulation of heavy metals in the environment is also an area of concern. It is feared that with increased mining in the catchment (Semalulu et al., 2005), biomass burning (Fitzgerald et al., 1998; Lockhart et al., 1998; Lucotte et al., 1999), factory activities such as tannery, fish processing, paint and paper manufacturing, wastes from hospitals and laboratories and the continued use of gasoline leaded fuel (Nriagu, 1992), concentrations of heavy metals associated with these processes are on the increase. In addition, increased soil erosion from the catchment, recent flooding events and continued high water levels over the last four decades could increase mobility of Hg previously sequestered in soil and lake sediments (Semalulu et al., 2005). Mercury and several other heavy metals pose a health hazard through bioaccumulation and biomagnification in the food chain.

One of the factors contributing to inappropriate handling and use of agrochemicals and the increased accumulation of heavy metals in the catchment is weak or non-existent policies, non-compliance by stakeholders, and poor enforcement. According to NEMA (2004/05), the existence of various policies and laws should simplify and make environmental management easier however the evidence on the ground is one of continued violations. There is a need therefore to identify appropriate ways to integrate research and the policy formulation process to craft appropriate policy strategies targeted to source areas and source sectors

Main objective 4.2.1. To assess the effects of agrochemicals on the environment and Public Health propose remedial measures

Researchable issues

i. Study the impact of agrochemicals on the food chain and propose options for remedial measures
ii. Assess the impacts of agrochemicals on human health including occupational
iii. Study the impact of the use of DDT to fight malaria on the environment and public health
iv. Update the database of possible sources of contaminants and map out hot spots (e.g. flower gardens)

Proposed methods

i. Participatory assessment of the use of agrochemicals and DDT on the environment and public health
ii. Scientific assessment and monitoring of soils, water, sediment, organisms for levels of contamination by agrochemicals and DDT
iii. Collect data on health of dealers, stockists, and farmers
iv. Collect scientific and social (including IK) data to map hotspots
v. Collect and update information on approved dealers, gazetteer chemicals, restricted-use chemicals, the banned agrochemicals, etc.

vi. Pilot options for mitigating the effects of contamination
vii. Any other methods to be proposed by the implementer

Expected outputs

i. The levels of contaminants in the food chain established
ii. Stakeholders sensitized and apply research findings in policy formulation
iii. Hotspots of contaminants identified
iv. An updated database of possible sources of contaminants established

Beneficiaries

i. Agrochemicals suppliers, dealers, stockists, and farmers
ii. Water quality managers
iii. Fisheries industry
iv. CBOs and NGOs
v. NEMA
vi. MAAIF
vii. Local Government

Monitorable Indicators

i. Data on types and amounts of agrochemicals in the water, sediments, and food chain
ii. An updated database

Main Objective 4.2.2. To generate empirical data on the safe handling and use of agrochemicals for policy formulation and implementation

Researchable issues

i. Review, develop and strengthen basin-wide policies, institutions and practices on use of key persistent chemicals with residual pollution effects
ii. Explore mechanisms to strengthen existing monitoring institutions e.g. Agrochemicals Control Board
iii. Propose appropriate ways to promote research-based policy formulation

Proposed methods

i. Review the existing policies, institutions and practices
ii. Review the existing information on agrochemicals and its accessibility to stakeholders
iii. Pilot a multi-sectoral and stakeholder study on appropriate application and management of agrochemicals
iv. Hold workshops/seminars/talk shows to advocate for research-based policy formulation
v. Any other methods to be proposed by the implementer

Expected outputs

i. Effective monitoring institutions
ii. Revised rules, regulations and standards on the use of agrochemicals
iii. Process change in policy formulation (research-based)

Beneficiaries

i. Policy makers (e.g. Parliament)
ii. CBOs and NGOs
iii. NEMA
iv. MAAIF
v. Local Government
vi. Government Departments and Agencies

Monitorable indicators
i. Conducive Policies and standards
ii. Improved monitoring systems of the institutions

4.1.5 THEMATIC AREA 5. AQUATIC WEEDS

Result Area 5.1. Sustainable control of water hyacinth and other invasive weeds

Introduction
Initial control of water hyacinth in the Ugandan portion of Lake Victoria was achieved in 1998 by means of integrated management strategy (NARO 2002). The control was however not achieved in River Kagera from where large quantities of the weed enter Lake Victoria all year round. Annual weed resurgence of increasing magnitude also ensued in the lake since 1999 (NARO 2001). The initial control of water hyacinth in the lake was accompanied by isolated proliferation of native water plants especially *Najas hornida, Hydrilla verticillata, Ceratophyllum demasum, Trapa natans Pistia stratiotes*, and *Azolla sp* (LVEMP 2005). The water plants became increasingly prolific accompanied by indications of negative ecological and socio-economic impacts. The purpose of this project is to identify and implement options and strategies that will lead to sustainable management of water hyacinth and other invasive water weeds in Lake Victoria and River Kagera.

Main Objective 5.1.1. Curb the proliferation of water hyacinth in River Kagera

Researchable issues
i. Identify and implement effective and sustainable regional management options for water hyacinth in River Kagera
ii. Mitigate weed biomass flow into Lake Victoria

Proposed methods
i. Develop a national strategy that includes coordination with regional stakeholders (especially Tanzania, Rwanda and Burundi) to identify and initiate effective and sustainable options;
ii. Explore options for mitigating weed biomass flow including enhancing the use of take-out elevators.
iii. Promote community participation in weed control and pilot community based weed management strategies
iv. Any other methods to be proposed by the implementer

Expected outputs

i. Effective national (and regional) water hyacinth control options developed
ii. Mechanisms for reducing inflow of water hyacinth into Lake Victoria enhanced
iii. Communities actively involved

Beneficiaries

i. Research institutions
ii. Fishery industry
iii. Water transport
iv. MAAIF
v. Communities
vi. NEMA

Monitorable indicators

i. Control strategy
ii. Options for biomass flow mitigation
iii. Community participation

Main Objective 5.1.2. Control annual resurgence of water hyacinth in Lake Victoria

Researchable issues

i. Research into factors (e.g. environmental, social, economic) sustaining resurgence of water hyacinth
ii. Identify and pilot options for effective control of water hyacinth

Proposed methods

i. Participatory research into factors (e.g. environmental, social, economic) sustaining resurgence of water hyacinth
ii. Pilot and promote options for effective control of water hyacinth

Expected outputs

i. Factors sustaining resurgence of water hyacinth identified
ii. Options for effective control of water hyacinth Identified and piloted

Beneficiaries

i. Research institutions
ii. Fishery industry
iii. Water transport
iv. MAAIF
v. Communities
vi. NEMA

Monitorable indicators

i. Factors for resurgence
ii. List of options for control

Main Objective 5.1.3: Curb proliferation of key native water plants to weed status

Researchable issues

i. Establish factors (e.g. environmental, social, economic) driving proliferation of native water plants to weed status
ii. Investigate the environmental and socio-economic impacts of proliferation of native water plants
iii. Research, enhance and pilot options for native weeds control

Proposed methods

i. Participatory research into factors driving proliferation of native water plants to weed status
ii. Participatory research into environmental and socio-economic impacts of proliferation of native water plants;
iii. Pilot and promote options for native weeds control

Expected outputs

i. Factors driving proliferation of native water plants established
ii. Environmental and socio-economic impacts identified
iii. Options for native weeds control enhanced

Beneficiaries

i. Research institutions
ii. Fishery industry
iii. Water transport
iv. MAAIF
v. Communities
vi. NEMA

Monitorable indicators

i. A list of factors
ii. List of impacts
iii. Control options

Result area 5.2. Effective national early warning mechanism for management of water hyacinth and other invasive water weeds

Introduction

The projects which contributed to the control of water hyacinth to less 20% of biomass cover on Lake Victoria did not put in place a mechanism to track water hyacinth on a sustainable basis. This omission contributed to a gap in information gathering and sharing among key stakeholders with respect to the status of distribution and proliferation of the weed. Water hyacinth resurgence has not been effectively monitored leading to delays in taking control action. The purpose of this project is to put in place an early warning mechanism to enable timely response in the management of invasive weeds in Lake Victoria Basin.

Main Objective 5.2.1. Develop and pilot early warning mechanisms

Researchable issues

i. Identify parameters necessary for developing early warning mechanisms (monitoring networks and facilities for data gathering, processing and sharing)
ii. Establish a centralized database
iii. Develop and pilot early warning mechanism

Proposed methods

i. Undertake participatory identification of gaps in existing monitoring and data gathering mechanisms for water hyacinth and other water weeds
ii. Carry out participatory identification of the most appropriate multi-stakeholder modalities for effective data collection, processing and sharing
iii. Assess the institutional and legal capacity and readiness to support operation of early warning mechanisms for water weeds
iv. Operationalize and pilot multi-stakeholder early warning options
v. Other methods to be proposed by the implementers

Expected outputs

i. Parameters for developing early warning mechanisms identified
ii. Multi-stakeholder modalities for effective data collection, processing and sharing developed
iii. Mechanisms for early warning evaluated on invasive weeds developed.

Beneficiaries

i. Research institutions
ii. Fishery industry
iii. Water transport
iv. MAAIF
v. Communities
vi. NWSC
vii. UEGCL
viii. NEMA
ix. Industry

Monitorable indicators

i. List of elements necessary for data collection, processing and sharing;
ii. Data collection and processing centre;
iii. Elements of shared data/information;
iv. An early warning model

4.1.6 THEMATIC AREA 6. SOCIO-ECONOMIC AND PRIVATE SECTOR DEVELOPMEMNT

Result Area 6.1. Generating options for boosting environmental health and community development

Introduction

Poverty in the basin is manifested mainly in poor health, low standards of living, living from hand to mouth, limited investments and general low development aspirations. People seem to have resigned to barely surviving. Health is particularly life threatening

and besides HIV/AIDS (to be addressed under the global fund), catchment communities are hot spots for several other communicable and vector borne diseases. The most prevalent diseases include malaria, dysentery, diarrhea, bilharzias, cholera, skin-related infections, intestinal worms, brucellosis, and Sleeping sickness (Tanzam, 2004). Direct causes of communicable diseases in the lake basin are associated with poor sanitation facilities, low potable water coverage, proximity to and frequency of direct contact with contaminated water, poor garbage collection and disposal and increasing population densities (Muyodi et al., 2005). There has been a number of public (Kapiriri 2005) and NGO initiatives aimed at improving the sanitation of fishing and other livelihoods communities, but while these have partly succeeded in towns, they seem not to have been as effective in fishing and other rural communities.

One of the main underlying challenges in facilitating disease control and community development has been the transient nature of communities in the catchment, especially the fisher folk and pastoralists. Utilization of natural resources can potentially lead to development of communities if appropriate participatory and economically viable options are developed. For instance, fishermen are known to earn substantial amounts of money that should, if appropriately used improve their standards of living. Unfortunately the money is squandered in drinking and prostitution, among others, and the people remain poor. In addition, mechanisms for coordination and harmonization to guide economic and natural resources development (Kalyebara 2005) are required. The proposed programme therefore aims at researching into adoption rates, causes and options for tackling environmental health and other behavior trends, as well as boost community development.

Main objective 6.1.1. To promote community-based environmental sanitation and disease control

Researchable issues

i. Investigate the underlying causes of the high prevalence of the communicable and vector borne diseases
ii. Examine and evaluate past community participatory interventions in water quality, quantity, supply and sanitation management
iii. Evaluate behavioral change interventions to mitigate communicable and vector borne diseases
iv. Assess options for establishing monitoring mechanisms for tracking communicable and vector borne diseases among transient populations.
v. Explore the use of traditional medicine in the treatment of communicable and vector borne diseases

Proposed methods

i. Scale up successful community participatory interventions in water quality, quantity, supply and sanitation management
ii. Participatory research to establish underlying socio-economic causes of persistence of poor hygiene, prevalence of communicable and vector borne diseases.
iii. Develop and pilot a tracking system for communicable and vector borne diseases among transient populations
iv. Document the use of herbal medicine in the treatment of communicable and vector borne diseases

v. Any other methods to be proposed by the implementer

Expected Outputs

i. Underlying causes of the high prevalence of the communicable and vector borne diseases identified
ii. Past community participatory interventions evaluated
iii. Behavioral change interventions evaluated
iv. Options for establishing monitoring mechanisms assessed
v. Tracking system developed and piloted
vi. Use of herbal medicine documented

Beneficiaries

i. Ministry of Health
ii. Fisheries
iii. Water and sanitation agencies
iv. Communities/NGO/CBOs
v. Local governments
vi. Researchers
vii. Private water developers

Monitorable indicators

i. Prevalence of the communicable and vector borne diseases
ii. Community participation
iii. Behavioral change
iv. Monitoring mechanisms
v. Tracking system
vi. Use of herbal medicine

Main objective 6.1.2. To promote synergies between sustainable natural resources management and community development for poverty alleviation

Researchable issues

i. Evaluate good practices (environmentally friendly strategies) for household waste management
ii. Examine existing appropriate technologies (e.g. energy saving technologies, alternative to natural resources such as building materials, packaging materials) for purposes of scaling up
iii. Research into ways of attracting/ interesting the Private Sector into Natural Resources Research
iv. Assess the profitability of prospective enterprises (e.g. aquaculture, water harvesting & storage, post-harvest handling and value addition) that improve livelihoods
v. Explore options for linking natural resources users to markets to increase net returns to households.
vi. Explore alternative and viable investments for fisher folks
vii. Evaluate the user-friendliness of existing micro-finance services for producer communities

Proposed methods

i. Participatory identification and scaling up good practices for household waste management
ii. Scale up identified appropriate technologies
iii. Develop strategies for attracting/ interesting the Private Sector into Natural Resources development and management
iv. Develop and pilot incentives and disincentives for private sector involvement in natural resources development
v. Multi-stakeholder assessment of the profitability of prospective enterprises
vi. Develop and pilot options for linking natural resources users to markets
vii. Participatory assessment of proven technologies for improving natural resources utilization by communities.
viii. Economic studies on scaleable technologies and enterprises for community development
ix. Develop and pilot alternative investments for fisher folks
x.
xi. Any other methods to be proposed by the implementer

Expected Outputs

i. Good practices for household waste management evaluated
ii. Appropriate technologies scaled up
iii. Strategies for attracting/ interesting Private Sector developed
iv. Profitability of prospective enterprises assessed
v. Options for linking natural resources users to markets developed and piloted
vi. Alternative viable investments for fisher folks developed and piloted
vii. User-friendliness of existing micro-finance services evaluated

Beneficiaries

i. Ministry of Health
ii. Water and sanitation department
iii. Fisheries Department, research
iv. UBOS
v. Communities/NGO/CBOs
vi. Local governments
vii. Researchers
viii. UIA
ix. Private water developers

Monitorable indicators

i. Household waste management
ii. Technologies
iii. Strategies
iv. Profitability
v. Options
vi. Investments
vii. Micro-finance services

Result Area 6.2. Generating options for enhancing private-public-community partnerships for sustainable natural resources based development

Introduction

Since independence, the public sector has endeavored to manage NR through law enforcement on one hand and promotion of economic development on the other. All stakeholders have come to the realization that communities and private sector need to come to the mainstream of natural resource management and development. Main issues identified from literature and interviews with stakeholders indicate strongly that there is widespread use of inappropriate technologies; limited coverage and inefficient use of energy saving technologies; lack of linkage between private sector and research; low, irregular and poor quality natural resources yields (livestock, fish and crops); low literacy levels, lack of alternative income sources to shelter households against unpredictable shocks, land tenure and freedom to invest in infrastructure development (Katurole and Wadanya 2005), deforestation in forestry reserves and inadequate resources for proper management; low marked incentives for increasing quality and enhancing yields, poor saving and investment by producer communities and under-developed/ underutilized tourism potential.

The time for law enforcement in the management of natural resources is quickly coming to an end. However the challenge is no longer resistance from conventional managers but the "how" of multi-stakeholder collaboration (Byabashaija 2005) without compromising natural resources protection and sound management. Three main objectives have been proposed to address the issues identified above:

Main Objective 6.2.1. Boosting NR yields to commercially sustainable levels: Private-community partnerships project for sustaining incomes of producer groups

Researchable issues

i. Evaluate past interventions in demand-driven research-extension for purposes of identifying good practices for linking farmers to markets and farm inputs (e.g. contract farming for sugar companies)
ii. Research into use & adoption of appropriate yield boost strategies (e.g. fish feeds, crop and livestock production technologies, soil fertility enhancement options, quality control and management)
iii. Boost local community incomes through sustainable use and management of natural resources
iv. Assess capacity of farmers to participate in market driven production
v. Assess the impact of land use policies and practices on private sector investment

Proposed methods

i. Scale up identified good practices for linking farmers to markets and farm inputs
ii. Develop and pilot strategies to boost natural resources yields
iii. Build capacity of farmers for market driven production

iv. Participatory monitoring mechanisms to evaluate the impacts of implementation of the revised fishing and land use policies and their impact on private sector investment
v. Scale up afforestation and co-management of forestry reserves through community participation
vi. Identify land use policies and practices that discourage private sector investment in natural resources
vii. Propose options for developing new policies and practices that promote private sector investment in natural resources
viii. Any other methods to be proposed by the implementer

Expected Outputs

i. Identified good practices scaled up
ii. Strategies to boost natural resources yields developed and piloted
iii. Capacity built
iv. Participatory monitoring mechanisms developed
v. Afforestation and co-management practices scaled up
vi. Land use policies and practices that discourage private sector investment identified
vii. Options for developing new policies and practices developed

Beneficiaries

i. Departments of community development
ii. NFA and District Forestry departments/environment
iii. Local governments
iv. Department of Agriculture and commerce
v. Fisheries
vi. NAADS
vii. Private sector

Monitorable indicators

i. Practices
ii. Strategies
iii. Capacity
iv. Participatory monitoring mechanisms
v. Afforestation and co-management practices
vi. Land use policies and practices
vii. Options

Main Objective 6.2.2. Exploring options for developing and publicizing the tourism potential of the basin (multi-stakeholder project for enhancing natural resources value to communities)

Researchable issues

i. Assess the performance of existing ecotourism projects
ii. Assess the potential of other tourist destinations for piloting
iii. Explore options for community participation in management and sharing of benefits with private sector agencies
iv. Examine options for joint development of tourism sites by interested stakeholders (geo-tourism, cultural tourism)

v. Assess capacity of local communities and private sector for participating in tourism projects

Proposed methods

i. Evaluate the performance of existing ecotourism projects
ii. Evaluate other potential tourist destinations for piloting
iii. Map out potential tourist destination for piloting
iv. Pilot a community-based and private sector tourism development of selected sites
v. Promote the documentation, publications and marketing of key sites
vi. Develop options for joint development of tourism sites by interested stakeholders
vii. Build capacity of local communities and private sector for participating in tourism projects
viii. Any other methods to be proposed by the implementer

Expected Outputs

i. Performance of existing ecotourism projects evaluated
ii. Potential tourist destinations for piloting evaluated
iii. Potential tourist destination for piloting mapped
iv. Community-based and private sector tourism development of selected sites piloted
v. Documentation, publications and marketing of key sites promoted
vi. Options for joint development of tourism sites by interested stakeholders developed
vii. Capacity of local communities and private sector built

Beneficiaries

i. Tourism
ii. Department of Community development
iii. Culture and antiquities
iv. Local communities/ local business community
v. Private hotels and tour companies
vi. Min of Local government

Monitorable indicators

i. Performance
ii. Potential of tourist destinations
iii. Map
iv. Piloted projects
v. Documentations, publications and markets
vi. Options
vii. Capacity

4.1.7 THEMATIC AREA 7. BIODIVERSITY OF THE LAKE VICTORIA BASIN

Result Area .7.1. Enhanced Biodiversity of the Lake and its Catchment

Introduction

The biodiversity of the Lake Victoria basin includes a wide range of life forms, ranging from micro-organisms to large vertebrates; different forms of plants ranging from ferns to higher plants. The lake basin is home of rare (extremely diverse in birds, mostly) aquatic and forest specialist bird species many of which are of high conservation significance. Out of the 30 Important Bird Areas (IBAs) in Uganda, 8 are located in the basin. The basin's richness in biodiversity is partly associated with its diverse of ecosystems (e.g. forests, wetlands, rangelands and various aquatic habitats). However since the 1960s, the loss of biodiversity has been growing at an alarming rate (Balirwa et al, 2003; Lowe-McConnell, 2004; Awange & Obiero Oganga, 2006). This loss has been attributed to increase in deforestation, wetland degradation and conversion, over-fishing, introduction of exotic species, pollution and the rapidly increasing human population. For example, about 40 percent of the endemic cichlid haplochromines have been lost since the 1960's (Balirwa et al 2003) and many wetlands and forest patches converted to farmland (Kairu, 2001). Several interventions to address biodiversity loss are ongoing. These include restoration of wetlands (WID, NEMA, VicRes), preparation of a biodiversity atlas by FIRRI (LVEMP 2005) through support from LVEMP I, identifying and monitoring IBAs (Byaruhanga, et al 2001) and designation of Ramsar sites (Ramsar Convention 2005). The proposed AR project therefore aims to contribute to the mitigation of biodiversity loss in the Lake basin.

Main Objective 7.1.1. To generate information on the status and processes of aquatic biodiversity changes

Researchable issues

i. Inventory the status of aquatic biodiversity (e.g. fish species, mammals, reptiles) in satellite lakes of the basin.
ii. Complete mapping of the distribution of aquatic biodiversity in Lake Victoria.
iii. To contribute to the knowledge base about the underlying causes of changes in biodiversity
iv. To assess the role of the microbial loop on biodiversity

Proposed methods

i. Evaluation of existing data on biodiversity in the lake and its catchment
ii. Develop community-based participatory approach of mapping of biodiversity
iii. Document the status of biodiversity in the satellite lakes
iv. Map biodiversity of offshore areas of the Lake Victoria and satellite lakes
v. Study the environmental factors that may contribute to changes in biodiversity
vi. Study the role of the microbial loop on biodiversity
vii. Any other methods to be proposed by the implementer

Expected Outputs

i. Existing data on biodiversity reviewed
ii. Biodiversity atlas of Lake Victoria and its satellite lakes developed
iii. Information on underlying causes of changes in biodiversity enriched
iv. Role of microbial loop understood

Beneficiaries

i. WID
ii. NEMA
iii. MAAIF
iv. Local Communities
v. Government Research Institutions
vi. Conservation NGOs

Monitorable indicators

i. Data on biodiversity
ii. Biodiversity atlas
iii. Underlying causes
iv. Information on microbial loop

Main objective 7.1.2. To restore sustainable populations of large mammalian herbivores and carnivores in the lake's catchment

Researchable issues

i. To identify and scale up good practices in community based wildlife management and conservation practices.
ii. Establish a participatory action process for recovery of populations of threatened species of wildlife.

Proposed methods

i. Scale up the Lake Mburo game hunting project
ii. Draw up and implement a community-based recovery action plan for threatened wildlife species
iii. Any other methods to be proposed by the implementer

Outputs

i. Good practices for wildlife management developed
ii. Action plans for the recovery of threatened wildlife populations developed

Beneficiaries

i. UWA
ii. MoTTI
iii. Tour operators
iv. Local communities

Monitorable indicators

i. Appropriate community based wildlife management practices
ii. Action plans

Main objective 7.1.3. Promote community-public-private sector management and conservation of wetland biodiversity

Researchable issues

i. Complete biodiversity inventory of critical wetlands
ii. Enhance the implementation of wetlands management plans for critical areas

iii. Enhance community-based interventions for the conservation of wildlife in selected wetlands
iv. Promote community-based wetlands management options (e.g. eco-tourism)

Proposed methods

i. Participatory review of existing wetlands management options
ii. Review existing biodiversity data on critical wetlands
iii. Pilot options for implementation of community-based management plans for critical wetlands
iv. Any other methods to be proposed by the implementer

Outputs

i. Biodiversity inventory of critical wetlands completed
ii. Management plans for critical wetlands enhanced
iii. Community-based interventions for the conservation of wetland wildlife enhanced
iv. Community-based wetlands management options promoted

Beneficiaries

i. WID
ii. NEMA
iii. Local Government
iv. Local communities

Monitorable indicators

i. Biodiversity inventories
ii. Management plans
iii. Community-based interventions
iv. Management options

Main objective 7.1.4. Review current policies and practices to inform the restoration of biodiversity in degraded rangelands

Researchable issues

i. Research into ways for halting rangeland biodiversity loss and enhancing their restoration
ii. Review existing policy on stocking rates and propose ways for alternative management practices

Proposed methods

i. Develop and implement a community-based recovery plan for rangelands through participatory approaches
ii. Develop and pilot research-based stocking policies and practices
iii. Any other methods to be proposed by the implementer

Expected Outputs

i. Proven community based rangelands biodiversity recovery plan piloted
ii. Appropriate policies for managing rangeland biodiversity developed

Beneficiaries

i. NEMA
ii. Local Government
iii. CBOs/NGOs
iv. Research Institutions
v. National Parks
vi. UWA
vii. Pastoralists

Monitorable indicators

i. Biodiversity recovery plans
ii. Policies

4.1.8 THEMATIC AREA 8. MANAGEMENT OF TRANS-BOUNDARY ISSUES

Introduction

Controversies across boarders and between user groups (national governments, local authorities, and local communities) over shared natural resources (e.g. water resources, farm land, grazing land, forest and wetland products) are becoming common in the basin and sometimes life threatening. These conflicts often arise due to scarcity of resources, some resources gaining economic importance, differences in the national statutes governing the use and management of the resources.

The Trans-boundary Diagnostic Analysis (TDA, 2006) and SAP (2006) for the Lake Victoria basin identified a number of trans-boundary issues with significant ecological, socio-economic and public health implications: poor land use, illegal fishing methods, pollution, infestation of water bodies by water hyacinth and other aquatic weeds, climate changes, hydraulic and water balance, inconsistencies in enabling environment in the areas of policy, legal and institutions.

Trans-boundary health concerns in literature such as bilharzias, Brucellosis, Tryponosomiasis, malaria, dysentery and diarrhoea, and HIV/AIDS; natural resources management concerns such as access to grazing area, control of water weeds, thefts, use of chemicals, and general approaches to management, all require more collaboration and harmonization of laws, policies and regulations across boundaries as part of the mitigation options.

The main purpose of the AR project is to develop mitigation measures for addressing conflicts, livestock diseases and crop pests, while promoting wise use of natural resources across the basin.

Result area 8.1. Promoting collaborative natural resources management and harmonization of key cross border policies

Main objective 8.1.1. Generate options for conflict management across borders

Researchable issues

i. Investigate underlying causes of conflicts (e.g. theft of fishing gears, piracy)

ii. Develop and pilot conflict management options for key conflict areas

Proposed methods

i. Assess existing data on causes of conflicts
ii. Participatory identification of factors contributing to conflict in resource use
iii. Participatory development and piloting of conflict mitigation measures
iv. Pilot participatory conflict resolution mechanism
v. Any other methods to be proposed by the implementers

Expected outputs

i. Underlying causes of conflicts
ii. A range of conflict management options

Beneficiaries

i. National governments and institutions
ii. Local governments
iii. Local communities
iv. EAC
v. LVBC

Monitorable indicators

i. List of underlying causes of insecurity
ii. Conflict management options

Main objective 8.1.2. Developing strategic management options for controlling crop pests and livestock diseases

Researchable issues

i. Conduct detailed survey to identify key trans-boundary management issues of major livestock diseases and crop pests
ii. Develop and pilot strategies for controlling of livestock diseases and crop pests

Proposed methods

i. Participatory identification and analysis of key trans-boundary management issues
ii. Develop and pilot participatory strategies for the control of livestock diseases and crop pests
iii. Any other methods to be proposed by the implementers

Expected outputs

i. Key trans-boundary management issues identified and analyzed
ii. Strategic management options developed

Beneficiaries

i. Farmers
ii. Government departments
iii. NGOs
iv. Research institutions
v. East African LV management

Monitorable indicators

i. Key trans-boundary management issues
ii. Management options

Main objective 8.1.3. Develop and promote mechanisms for regulating and coordinating Trans-boundary trade and commerce

Researchable issues

i. Examine existing policies and regulations on Trans-boundary trade and commerce
ii. Evaluate policies, standards and regulations for cross-border trade and commerce
iii. Develop mechanisms for formalizing and regulating cross-border trade and commerce

Proposed methods

i. Desk review of the existing policies/regulations to identify key areas for revision
ii. Participatory review and revision of key policies, standards and regulations
iii. Identify and propose areas for revision in the policies, standards and regulations for cross-border trade and commerce
iv. Database development for recording origin, quantities and destinations of natural resources products
v. Pilot mechanisms for cross-border trade and commerce policy implementation
vi. Any other methods to be proposed by the implementers

Expected outputs

i. Existing policies and regulations reviewed
ii. Policies, standards and regulations revised or developed
iii. Mechanisms for formalizing and regulating cross-border trade and commerce piloted

Beneficiaries

i. Farmers
ii. Government departments
iii. NGOs
iv. Research institutions
v. Traders
vi. Custom officials
vii. Fisher folk
viii. EAC

Monitorable indicators

i. Policies and regulations
ii. Pilot

Results Area 8.2. Promote Effective Environmental Governance through Institutional Collaboration and Harmonization of Laws and Policies

Introduction

Environmental governance covers rules, processes and behaviour that affect the way powers are exercised by the institutions in the field of environmental laws and policies. In particular, effective environmental governance requires openness, participation, accountability and coherence.

Lake Victoria is an international waterbody that offers the riparian communities a large number of extremely important environmental services. Over the past three decades, the lake has come under increasing and considerable pressure from a variety of interlinked human activities such as over-fishing, species introductions, pollution, eutrophication and sedimentation. This requires improvement in environmental governance of the transboundary aspects of Lake Victoria.

Previous studies such as the Trans-boundary Diagnostic Analysis (TDA, 2006) have noted that the 1990s showed remarkable development of environmental policies, laws and Institutions. It is also important to note that planning framework for environmental management should be focused on management roles and procedures in more elaborate and specific terms in order to create conditions for effective monitoring of results.

The lack of harmonized laws and policies in the basin is one of the major impediments to enforcement of environmental laws. This, coupled with other problems such as political interventions in enforcement of environmental laws and policies, laxity in law enforcement, conflicting directives from central and local government, lack of awareness and inadequate capacity make effective environmental governance difficult.

The main purpose of this result area is to enhance environmental governance at the local, national and regional levels by promoting effective institutional collaboration and harmonization of laws and policies.

Main Objective 8.2.1. Generate Strategies for Effective Trans-boundary Environmental Governance

Researchable issues

i. Investigate the underlying causes of ineffective enforcement of environmental laws and policies
ii. Propose strategies for harmonization of trans-boundary environmental laws
iii. Propose options for intervention to ensure effective environmental governance

Proposed methods

i. Examine the existing laws, policies and institutional framework for environmental governance and identify causes of lack of effective implementation of laws and policies
ii. Participatory piloting of mechanisms for environmental governance using existing laws, policies and institutional frameworks
iii. Piloting participatory multi-stakeholder options for interventions to ensure effective environmental governance

iv. Any other methods to be proposed by the implementer

Expected Outputs

i. Existing laws, policies and institutional framework for environmental governance reviewed
ii. Mechanisms for environmental governance piloted
iii. Multi-stakeholder options for interventions piloted

Beneficiaries

i. EAC
ii. NBI
iii. National Governments and Institutions
iv. LVBC
v. Local Communities
vi. Local governments
vii. The East African Court of Justice

Monitorable indicators

i. Laws, policies and institutions
ii. Mechanisms for environmental governance
iii. Multi-stakeholder options

4.1.9 THEMATIC AREA 9. DATA AND DATABASE MANAGEMENT

Result Area 9.1. Improved data collection, processing, storage and management

Introduction

The existence of data/information from previous, on-going and planned research projects provides an opportunity to establish baseline (in terms of the dataset) for the applied research themes. Because a database is central to research, it is essential to define a database first. Technically a database is defined as a logical collection of integrated data/Information managed and stored as a unit usually on some form of mass storage devices such as magnetic tapes and computer disks. However it is also important to note that outputs (such as database and information) are not ends themselves. Both the database and information must be translated into outcomes (such as improved policy formulation and implementation, improved rational decision making, restoration/halting natural resources degradation, and improvement in human well-being). However, the existing data and databases are characterized by lack of harmonized standards for data collection and storage, lack of enabling environment for data sharing and limited capacity to manage the data and databases.

The AR for data and database management will emphasize the need and procedures for collecting data (by countries, projects, research teams and individuals) so that data can be seamlessly integrated for common purpose-generation of information for improved decision making and formulation and implementation of polices. LVEMP 2 projects will generate data/ information necessitating the set up of a Data and Information Centre which will enclose a functional, integrated, interactive and automotive database.

We are proposing creation of GIS database for managing data generated on environmental issues because of its various advantages including its user-friendliness, ease of integration of various parameters, capacity to store data in different formats and sizes and ease of networking.

Main objective 9.1.1. To standardize methods for data collection and handling to facilitate networking among key stakeholders

Researchable issues

i. To standardize methods for collection of data on key parameters to improve the quality and usability of data through creating metadata
ii. Enhance stakeholder capacity (human and infrastructure)
iii. Enhance capacity for trend analysis of environmental parameters/systems

Proposed methods

i. Review current parameters being measured
ii. Participatory identification and standardization of the methods used for data collection
iii. Develop and pilot standard methods for data collection, handling and processing for key parameters
iv. Enhance stakeholder capacity through training and infrastructure development
v. Enhance stakeholder capacity for trends analysis
vi. Any other methods to be proposed by the implementers

Expected Outputs

i. Standard methods for key parameters developed
ii. Stakeholder capacity enhanced

Beneficiaries

i. Water Resources Management Institutions
ii. The fisheries sector NAFIRRI
iii. Environmental Health Department (MoH)
iv. HIMS (MoH)
v. The stakeholders involved in water resources monitoring include the private sector, local government, NGOs and CBOs.
vi. Researchers

Monitorable indicators

i. Standard methods for key parameters
ii. Capacity

Main objective 9.1.2. Building capacity for creation and use of GIS database for networking

Researchable issues

i. Building capacity (human and infrastructure)
ii. Develop a seamless web based GIS database management system
iii. Set up user rights for database access
iv. Standardize the storage and management of data

Proposed methods

i. Review the setup of the available databases
ii. Build capacity
iii. Design and pilot a database management system
iv. Develop mechanisms for access to database
v. Any other methods to be proposed by the implementers

Expected outputs

i. Information on existing databases reviewed
ii. Capacity built
iii. GIS database developed
iv. Mechanisms for accessing databases developed

Beneficiaries

i. Water Resources Management Institutions
ii. The fisheries sector NAFIRRI
iii. Environmental Health Department (MoH)
iv. HIMS (MoH)
v. The stakeholders involved in water resources monitoring include the private sector, local government, NGOs and CBOs
vi. Researchers

Monitorable indicators

i. Information on existing databases
ii. Capacity
iii. GIS database
iv. Mechanisms for accessing databases

4.2 LOGFRAME FOR THE PROPOSED ARP SHOWING THE THEMATIC AREAS, COSTED ACTIVITIES AND MEANS OF VERIFICATION

The logical framework analysis for the proposed AR activities is presented in Table 2. This LFA presents a summary of the design of the programme. In addition to the overall goal and purpose, the log frame provides research areas, activities, Objectively Verifiable Indicators (OVI), Means of Verification (MOV) and assumptions underlying the design of the ARP. The budget for the costed activities under each activity is also presented.

Table 2. Logical Framework for the proposed ARP

OVERALL GOAL	**OVERALL LVEMP II GOAL**	To achieve sustainable development, growth and poverty reduction in the Lake Victoria basin		
Purpose	**AR purpose**	Applied Research Programme to enhance sustainable development, growth and poverty reduction in the Lake Victoria basin		
THEMATIC AREA 1	**THEMATIC AREA 1. CAPTURE FISHERIES AND AQUACULTURE**			
	Result area 1.1	**OVI**	**MOV**	**Assumptions**
	Enhancing fish catches and biodiversity	i. Mechanisms for controlling use of illegal fishing gears and methods ii. Strategies for Capture Fisheries Management iii. Information fishing technologies, biodiversity and management of satellite lakes	i. Beneficiaries reports ii. Field verification visits iii. Routine monitoring reports	i. Political stability ii. Resources availability iii. Stakeholder readiness to participate
	Activity 1.1.1.	**Detailed tasks**	**COST (USD)**	**Time frame**
Activity 1.1.	**To devise**	i. Assess the extent of the use of illegal	70,000	Jan-Dec 2008

	mechanisms for effective control of use of illegal fishing gears and methods		fishing gears and methods.		
		ii.	Explore options for controlling the use of illegal fishing gears and methods.	100,000	Jan-Dec 2008
		iii.	A review of current institutional mechanisms and arrangements and propose ways of strengthening them.	130,000	Jan-June 2008
		iv.	Establish underlying social and economic factors that prevent adherence to policies, regulations and by-laws.	40,000	Jan-June 2008
		v.	Develop options for assessing the effectiveness of control mechanisms of illegal gears and methods on fish stock enhancement	30,000	Jan 2008-Dec 2009
		vi.	Others	20,000	
Activity	**1.1.2. To generate information to inform the protection and enhancement of biodiversity for increased fish production**	i.	To identify critical biodiversity hot spots (e.g. key fish breeding and nursery habitats as well as fish refugia) for protection.	180,000	Jan 2008-Dec 2009
		ii.	To identify and monitor the effects of lake level fluctuations on breeding and nursery of fish biodiversity (especially major commercial fish species).	60,000	Jan 2008-Dec 2012
		iii.	Explore mechanisms for enhancing fish stocks in the main lake.	40,000	Jan 2009-Dec 2012
		lv.	Develop mechanisms for sustainably managing fish stocks in the lake.	50,000	Jan 2009-Dec 2012
		v.	Develop options for protecting fish breeding grounds	50,000	Jan 2010-Dec 2012
		vi.	Others	20,000	
	Result area	**OVI**		**MOV**	**Assumptions**
Result Area 1.2.	**Reduction of fish post harvest losses**	i. ii.	Low cost post harvest technologies Adoption rates of the developed technologies	i. Field visits ii. Adoption rates	i. Political stability ii. Community

				acceptance of technology
	Activity	**Detailed tasks**	**COST**	**Time frame**
Activity 1.2.1	**Activity 1.2.1. Developing technologies and practices for reduction of fish post harvest losses among artisan fisher folks**	i. Establish the extent and underlying causes of post harvest losses	5,000	Jan 2008 – Dec 2009
		ii. Enhance low-cost technologies and capacity to process and preserve fish	55,000	June 2009 -Jun 2010
		iii. Explore options for obtaining credit facilities for artisan fisher folks	85,000	Jan - Dec 2008
		iv. Explore mechanisms for developing infrastructure for fish handling, transportation, processing and marketing	5,000	Jun 2010 –Jun 2011
		v. Improve hygiene and sanitation at the landing sites	10,000	Jan 2008 – Dec 2012
		vi. Others	20,000	
	Result area	**OVI**	**MOV**	**Assumptions**
Result Area 1.3.	**Development of Economically Viable Aquaculture in the Lake Victoria Basin**	i. Information packages on aquaculture management. ii. Fish seeds variety iii. Fish feeds quality	i. Beneficiaries reports ii. Review participatory missions iii. Routine monitoring reports	i. Political stability ii. Availability of resources iii. Private sector will be interested
	Activity	**Detailed tasks**	**COST**	**Time frame**
	1.3.1. To improve aquaculture management practices	i. To compile, package and disseminate information on available technologies on pond siting, construction, stocking, and management of appropriate fish species for culturing	88,000	Jan 2008-Dec 2012
		ii. To explore options for funding to up-scale aquaculture	50,000	Jan 2011-Dec 2012
		iii. Others	20,000	

	1.3.2. Increase the Production of Improved and Better Quality Seeds of Different Culture Species	i. Evaluate the quality of existing aquaculture fish seeds ii. Scale up the use of low-cost technologies in production of high value and good quality aquaculture fish seeds iii. Develop options for adopting new culture species iv. Others	75,000 95,000 30,000 20,000	Jan 2008-Dec 2009 Jan 2009-Dec 2012 Jan 2009-Dec 2012
	1.3.3. To improve on the quality and cost-effectiveness of fish feeds developed from local and exotic ingredients	i. Evaluate existing fish feeds and establish quality appropriate for optimum fish growth. ii. Develop and pilot fish feeds for the various fish species. iii. Promote the use of local ingredients in the production of fish feeds iv. Others	25,000 80,000 50,000 20,000	Jan 2008-Dec 2009 Jan 2010-Dec 2012 Jan 2011-Dec 2012
	1.3.4. To establish the viability of culturing Nile perch	i. Establish the optimum environmental conditions for the Nile perch fry survival and growth ii. Identify suitable food items for cultured Nile perch & Formulate and evaluate feeds for optimum growth iii. Establish the optimum marketable size of cultured Nile perch iv. Evaluate the cost-effectiveness and market of cultured Nile perch v. Others	40,000 70,000 10,000 10,000 20,000	Jan 2008 –Dec 2012 Jan 2008 – Dec 2012 Jan –Dec 2012 Jan - Dec 2012
	1.3.5. To establish the feasibility of cage culture in	i. Establish environmental conditions for cage culture ii. Evaluate the suitability and profitability of different species for cage culture	30,000 20,000	Jan 2008 – Dec 2010 Jan 2008-Dec 2009

	the Lake Victoria Basin	iii. Identify suitable feeds for cage culture iv. Establish suitability of different sites and cages v. Establish an environmental monitoring programme vi. Assess the acceptability of cage culture vii. Propose institutional and legal framework for cage culture viii. Identify fish diseases under cage culture and develop preventive measures ix. Others	30,000 15,000 10,000 15,000 20,000 55,000 20,000	Jan-Dec 2010 Jan-Dec 2009 Jan 2008 – Dec 2012 Jan-Dec 2008 Jan – Dec 2009 Jan 2008-Dec 2012
THEMATIC AREA 2	**WATER QUALITY AND QUANTITY**			
	Result area 2.1	**OVI**	**MOV**	**Assumptions**
	Appropriate waste and water treatment technologies	i. Data on waste treatment technology ii. New sites implementing the Kirinya model	i. Progress reports on available data ii. Sites visits to new sites	i. Political stability ii. Cooperation among stakeholders iii. Timely financial commitments
	Activity 2.1.1	**Detailed tasks**	**COST**	**Time frame**
Activity	**To Scale up the Successful Kirinya Waste Treatment Project and Develop Technologies for use in the Collaborative Treatment of Wastes**	i. Evaluate Kirinya pilot project ii. Pilot and scale up the Kirinya Tertiary Municipal Effluent Treatment Pilot Project in the Murchison Bay and Namiiro wetlands iii. Explore options for effective multi-stakeholder waste treatment technologies iv. Develop effective multi-stakeholder	20,000 255,000 20,000 50,000	Jan 2008- Dec 2012 Jan 2008 –Dec 2012 Jan – Dec 2008

		waste (wastewater, solid waste and gas emissions) treatment technologies and strategies for technology transfer		Jan 2009 –Dec 2012
		v. Build capacity to recycle / reuse waste products by key stakeholders	300,000	
		vi. Promote generation of useful by-products (such as biogas and manure) and positive attitudes towards their use	50,000	Jan – Dec 2009
		vii. Others	40,000	
	Result area 2.2	**OVI**	**MOV**	**Assumptions**
Result Area	**2.2. Low-Cost Home-Based Water Treatment Technology and Sanitation Improvement**	i. Water quality improved ii. Reduction in prevalence of water-related diseases	i. Field visits ii. Clinical or medical records	i. Stakeholders will be committed ii. Cooperation between local government, other relevant, institutions
	Activity	**Detailed tasks**	**COST**	**Time frame**
	2.2.1 Develop technologies for purifying water and to improve house-hold sanitation	i. Assess the quantity and quality of water supplied to selected communities.	20,000	Jan 2008 – Dec 2012
		ii. Examine and recommend important alternative sources of water to the communities.	10,000	Jan –Dec 2009
		iii. Improve sanitary conditions and reduce waterborne disease prevalence in the selected communities.	40,000	Jan 2008 – Dec 2012
		iv. Develop cheap innovative measures	10,000	Jan –Dec 2009

		to prevent waterborne diseases. v. Assess the suitability of Moringa (*Moringa oleifera* Lam) and other cheaper alternatives to purify water at the household level. vi. Scale up Nsumba model village sanitary and hygienic practices. vii. Others	13,000 70,000 30,000	Jan –Dec 2008 Jan 2008 – Dec 2012
	Activity	**OVI**	**MOV**	**Assumptions**
Result Area	**2.3. Water Quality and Quantity Modelling in Lake Victoria Basin**	i. Ability of the model to predict trends in water quality and quantity in Lake Victoria Basin	i. Model	i. Cooperation amongst stakeholders ii. Resources availability
	Activity	**Detailed tasks**	**COST**	**Time frame**
	2.3.1. To complete and operationalize the Lake Victoria Water Quality Model (LVWQM)	i. Generate additional data for operationalising the model ii. Develop capacity (human and infrastructure) to run the model iii. Calibrate and test the model iv. Use the LVWQM to predict trends v. Others	30,000 171,000 40,000 10,000 10,000	Jan – Dec 2008 Jan 2008 – Dec 2009 Jan 2008 – Dec 2009 Jan 2010 – Dec2012
	2.3.2. Update the Water Balance Model to predict changes in water quantity	i. Establish new and utilize existing networks (where they exist) in the catchment for data collection on water quantity ii. Evaluate the relationship between ground water fluctuations and lake levels iii. Assess the contribution of groundwater to lake pollution iv. Collect additional data (including	5,000 80,000 65,000 20,000	Jan –Dec 2008 Jan 2009 – Dec 2010 Jan 2009 – Dec 2010 Jan 2009 – Dec 2010

		baseflow) for use in updating the model		
		v. Build capacity (human & infrastructural)	415,500	Jan – Dec 2008
		vi. Update the model to predict trends in water quantity (inflows and outflows)	50,000	Jan 2011 – Dec 2012
		vii. Analyze trends in the flow quantities, rainfall and evaporation in order to manage the lake basing on the dynamics of the regime.	10,000	Jan 2011 – Dec 2012
		viii. Evaluate the current Water Release Policy and propose a new one	5,000	Jan 2009 – Dec 2009
		ix. Develop a Water Discharge Support System.	5,000	Jan 2009 – Dec 2009
		x. Others	20,000	
	Result area	**OVI**	**MOV**	**Assumptions**
Result Area 2.4.	**Result Area 2.4 Sedimentation in Lake Victoria**	i. Number of pelagic and littoral stations increased and operationalized ii. Rates of sedimentation and siltation assessed iii. Bathymetric map generated	i. Data on sedimentation rates ii. Bathymetric map	i. Resources availability ii. Cooperation amongst key stakeholders
	Activity 2.4.1.	**Detailed tasks**	**COST**	**Time frame**
Activity	**To assess rates of sedimentation and siltation on Lake Victoria and to generate a bathymetric map**	i. Establish the number of littoral and pelagic stations required for monitoring the rates of siltation and sedimentation	5,000	Jan 2008 – Dec 2008
		ii. Generate baseline data on the rates of sedimentation and siltation	25,000	Jan 2008 – Dec 2012
		iii. Establish a monitoring programme	48,000	Jan 2011 – Dec 2012
		iv. Transport costs	30,000	Jan 2009 – Dec 2012

		v. Generate data on the chemistry of the sediments at different depths	50,000	Jan 2009 – Dec 2012
		vi. Generate data to assess climatic changes	110,000	Jan 2009 – Dec 2009
		vii. Generate data to contribute to the bathymetric map of Lake Victoria	150,000	
		viii. Others	20,000	
THEMATIC AREA	**THEMATIC AREA 3. ATMOSPHERIC DEPOSITION OF NUTRIENTS**			
	Result Area 3.1.	**OVI**	**MOV**	**Assumptions**
Atmospheric Deposition	**Establish the Effects of Atmospheric pollutant depositions on the Lake Ecosystem**	i. List of the effects of atmospheric pollutant depositions on the lake	i. Scientific reports ii. Impact and adoption surveys iii. Site visits iv. Quarterly monitoring reports v. Database	Stability Funds available
	Activity 3.1.1	**Detailed tasks**	**COST**	**Time frame**
Activity	**To Update Data on Sources and Quantities of Atmospheric Pollutants Entering Lake Victoria and Come Up with Mitigation Measures to Avert the Associated Problems**	i. Assess the contribution of atmospheric pollutants (including nutrient depositions) on Lake Victoria.	7,000	Jan 2008 – Dec 2012
		ii. Determine the sources, quantities, and routes of atmospheric pollutants entering the lake.	180,000	Jan 2009 – Dec 2012
		iii. Determine necessary actions to control and address the impairment caused by atmospheric pollutant depositions	279,000	Jan 2010 – Dec 2012

		iv. Others	36,000	
THEMATIC AREA 4	**CATCHMENT MANAGEMENT**			
	Result area 4.1	**OVI**	**MOV**	**Assumptions**
Catchment management	**The River Bukora Integrated Watershed Management**	i. Management options for rangelands, forests, farmlands and wetlands ii. Community-based monitoring system for biodiversity and water quality	i. Beneficiaries reports ii. Review missions reports iii. Routine monitoring reports iv. Project reports v. Field visits	i. Political stability ii. Resources availability
	Activity	**Detailed tasks**	**COST**	**Time frame**
Activity 4.1.	**4.1.1: Developing and promoting better and sustainable rangeland and forestry management strategies**	i. Determine the magnitude, effects and monetary value of rangeland and forest degradation ii. Develop and upscale viable management options for rangelands and forests iii. Build capacity and systems for multi-stakeholder management of rangeland and forestry resources iv. Others	109,000 270,000 50,000 20,000	Jan 2009 – Dec 2011 Jan 2009 – Dec 2011 Jan 2008 – Dec 2008
Activity	**4.1.2. Promoting improved management strategies for cultivated farmlands of River Bukora catchment**	i. Identify and upscale economically viable farming practices (building on LVEMP 1 and other pilot studies in the region) e.g. integrated soil fertility and water management, water harvesting, integrated pest management, agro-forestry and crop livestock integration)	20,000	Jan 2008 – Dec 2008

		ii. Build capacity of farmers and service providers in support of improved farming practices	180,000	Jan 2008 – Dec 2009
		iii. Strengthen local institutions (e.g. local leaders, CBOs, women groups) for monitoring and enhancing adoption of improved farming practices	60,000	Jan 2008 – Dec 2009
		iv. Others	20,000	
	4.1.3. Restoration of ecosystem functioning of selected wetlands in the River Bukora catchment	i. Promotion of community participation in the management and restoration of selected wetlands in the catchment	75,000	Jan 2009 – Dec 2008
		ii. Generation of management options for enhancing biodiversity and buffering capacity of the selected wetlands	225,000	Jan 2008 – Dec 2010
		iii. Others	20,000	
	4.1.4. Piloting mechanisms for monitoring to assess the effects of improved catchment management on siltation and sedimentation in the River Bukora system	i. Assess the importance of siltation and sedimentation in the Bukora catchment	25,000	Jan – Jun 2008
		ii. Develop and pilot mechanisms for monitoring siltation and sedimentation of water bodies in the catchment	170,000	Jan 2009 – Dec 2011
		iii. Others	20,000	
	Result area 4.2:	**OVI**	**MOV**	**Assumptions**
	The Effects of Inappropriate Handling and Use	i. List of the various effects of inappropriate handling and use of agrochemicals on the environment	i. Database ii. Quarterly reports	i. Political stability ii. Available of

	of Agrochemicals on the Environment and Public Health		iii. Awareness and impact surveys iv. Community action plans v. Conducive policies and standards vi. Beneficiary reports	resources iii. Stakeholder participation
	Activity	**Detailed tasks**	**COST**	**Time frame**
Activity	**4.2.1. To assess the effects of agrochemicals on the environment and Public Health propose remedial measures**	i. Study the impact of agrochemicals on the food chain and propose options for remedial measures ii. Assess the impacts of agrochemicals on human health including occupational iii. Study the impact of the use of DDT to fight malaria on the environment and public health iv. Update the database of possible sources of contaminants and map out hot spots (e.g. flower gardens) v. Others	50,000 90,000 100,000 60,000 30,000	Jan 2008 – Dec 2012 Jan 2008 – Dec 2012 Jan 2008 – Dec 2012 Jan 2011 – Dec 2012
Activity	**4.2.2. To generate empirical data on the safe handling and use of agrochemicals for policy formulation and implementation**	i. Review, develop and strengthen basin-wide policies, institutions and practices on use of key persistent chemicals with residual pollution effects ii. Explore mechanisms to strengthen existing monitoring institutions e.g. Agrochemicals Control Board iii. Propose appropriate ways to promote research-based policy	20,000 52,000 35,000	Jan - June 2008 Jan –Dec 2008 Jan –Dec 2008

		formulation iv. Others	18,000	
THEMATIC AREA	**THEMATIC AREA 5. AQUATIC WEEDS**			
	Result Area 5.1.	**OVI**	**MOV**	**Assumptions**
	Sustainable control of water hyacinth and other invasive weeds	i. Options for controlling water hyacinth and other invasive weeds	i. Functioning mechanisms ii. Field visits iii. Routine monitoring reports	i. Political stability ii. Resources availability
	Activity	**Detailed tasks**	**COST**	**Time frame**
Activity 5.1.	**5.1.1. Curb the proliferation of water hyacinth in River Kagera**	i. Identify and implement effective and sustainable regional management options for water hyacinth in River Kagera	90,000	Jan 2008 –Dec 2009
		ii. Mitigate weed biomass flow into Lake Victoria	100,000	Jan 2008 –Dec 2009
		iii. Others	20,000	
Activity	**5.1.2. Control annual resurgence of water hyacinth in Lake Victoria**	i. Research into factors (e.g. environmental, social, economic) sustaining resurgence of water hyacinth	30,000	Jan 2008 –Dec 2010
		ii. Identify and pilot options for effective control of water hyacinth	60,000	Jan 2009 –Dec 2011
		iii. Others	20,000	
	5.1.3: Curb proliferation of key native water plants to weed status	i. Establish factors (e.g. environmental, social, economic) driving proliferation of native water plants to weed status	20,000	Jan 2008 –Dec 2009
		ii. Investigate the environmental and socio-economic impacts of	30,000	Jan 2008 –Dec 2009

		proliferation of native water plants iii. Research, enhance and pilot options for native weeds control iv. Others	30,000 10,000	Jan 2010 –Dec 2012
	Result Area	**OVI**	**MOV**	**Assumptions**
Result Area 5.2.	**5.2. Effective national early warning mechanism for management of water hyacinth and other invasive water weeds**	i. Early warning mechanisms	i. Functioning mechanisms ii. Field visits iii. Routine monitoring reports	i. Political stability ii. Resources availability
	Activity	**Detailed tasks**	**COST**	**Time frame**
Activity	**5.2.1. Develop and pilot early warning mechanisms**	i. Identify parameters necessary for developing early warning mechanisms (monitoring networks and facilities for data gathering, processing and sharing) ii. Establish a centralized database iii. Develop and pilot early warning mechanism iv. Others	10,000 10,000 20,000 10,000	Jan – Dec 2008 Jan - Dec 2009 Jan - Dec 2010
THEMATIC AREA	**THEMATIC AREA 6: SOCIO-ECONOMICS AND PRIVATE DEVELOPMENT**			
	Result Area 6.1	**OVI**	**MOV**	**Assumptions**
	Generating options for boosting environmental	i. Changes in sanitation behavior and practices ii. Collaborative Natural Resources based economic enterprises	i. Tracking system ii. Beneficiaries reports	i. Political stability ii. Resources availability

	health and community development	iii. Appropriate credit facilities iv. Active involvement of private sector and communities	iii. Review participatory missions iv. Routine monitoring reports	
	Activity 6.1.1	**Detailed tasks**	**COST**	**Time frame**
	To promote community based environmental sanitation and disease control	i. Investigate the underlying causes of the high prevalence of the communicable and vector borne diseases	25,000	Jan 2008 - Dec 2010
		ii. Examine and evaluate past community participatory interventions in water quality, quantity, supply and sanitation management	75,000	Jan –Dec 2008
		iii. Evaluate behavioral change interventions to mitigate communicable and vector borne diseases	50,000	Jan 2009 – Dec 2011
		iv. Assess options for establishing monitoring mechanisms for tracking communicable and vector borne diseases among transient populations.	78,000	Jan 2010 – Dec 2011
		v. Explore the use of traditional medicine in the treatment of communicable and vector borne diseases	20,000	Jan 2008 - Dec 2012
		vi. Others	20,000	
Activity	**6.1.2 To promote synergies between sustainable Natural resource management and community**	i. Evaluate good practices (environmentally friendly strategies) for household waste management	45,000	Jan 2008 - Dec 2009
		ii. Examine existing appropriate technologies (e.g. energy saving technologies, alternative to natural resources such as building materials,	60,000	Jan – Dec 2008

	development for poverty alleviation	packaging materials) for purposes of scaling up iii. Research into ways of attracting/ interesting the Private Sector into Natural Resources Research iv. Assess the profitability of prospective enterprises (e.g. aquaculture, water harvesting & storage, post-harvest handling and value addition) that improve livelihoods v. Explore options for linking natural resources users to markets to increase net returns to households. vi. Explore alternative and viable investments for fisher folks & Evaluate the user-friendliness of existing micro-finance services for producer communities vii. Others	48,000 75,000 75,000 30,000 20,000	Jan 2008 - Dec 2009 Jan 2010 - Dec 2012 Jan 2010 - Dec 2012 Jan 2009 - Dec 2011
	Result area 6.2.	**OVI**	**MOV**	**Assumptions**
	Generating options for enhancing private-public-community partnerships for sustainable natural resources based development	i. New natural resources based economic enterprises ii. Collaborative initiatives between research and private sector iii. New tourist sites opening up iv. Private-community benefit sharing modalities in place v. Infrastructure development	i. Beneficiaries reports ii. Review participatory missions iii. Routine monitoring reports	i. Political stability ii. Availability of resources iii. Private sector will be interested
	Activity	**Detailed tasks**	**COST**	**Time frame**

	6.2.1. Boosting NR yields to commercially sustainable levels: Private-community partnerships project for sustaining incomes of producer groups	i.	Evaluate past interventions in demand-driven research-extension for purposes of identifying good practices for linking farmers to markets and farm inputs (e.g. contract farming for sugar companies)	54,000	Jan 2008 –Dec 2010
		ii.	Research into use & adoption of appropriate yield boost strategies (e.g. fish feeds, crop and livestock production technologies, soil fertility enhancement options, quality control and management)	42,000	Jan 2010 - Dec 2012
		iii.	Boost local community incomes through sustainable use and management of natural resources	75,000	Jan 2009 - Dec 2010
		iv.	Assess capacity of farmers to participate in market driven production	70,000	Jan 2008 –Dec 2012
		v.	Assess the impact of land use policies and practices on private sector investment	42,000	Jan 2008 –Dec 2012
		vi.	Others	20,000	
	6.2.2. Exploring options for developing and publicizing the tourism potential of the basin (multi-stakeholder project for enhancing natural resources value to communities)	i.	Assess the performance of existing ecotourism projects	10,000	Jan –Dec 2008
		ii.	Assess the potential of other tourist destinations for piloting	81,000	Jun 2008 –Dec 2010
		iii.	Explore options for community participation in management and sharing of benefits with private sector agencies	74,000	Jan 2011 –Dec 2012
		iv.	Examine options for joint development of tourism sites by interested stakeholders (geo-tourism, cultural tourism)	57,000	Jan 2008 –Dec 2009
		v.	Assess capacity of local communities and private sector for participating in tourism projects	51,000	Jan 2010 –Dec 2012
		vi.	Others	20,000	

THEMATIC AREA 7	THEMATIC AREA 7: BIODIVERSITY			
	Result area 7.1.	**OVI**	**MOV**	**Assumptions**
	Enhanced biodiversity of the lake and its catchment	i. Baseline biodiversity data	i. Biodiversity atlas ii. Information on changes in invertebrate diversity	i. Political stability ii. Resources availability iii. Cooperation of stakeholders
	Activity	**Detailed tasks**	**COST**	**Time frame**
Activity 5.1.	**7.1.1. To generate information on the status and processes of aquatic biodiversity changes**	i. Inventory the status of aquatic biodiversity (e.g. fish species, mammals, herpetiles) in satellite lakes of the basin.	45,000	Jan 2008-Dec 2010
		ii. Complete mapping of the distribution of aquatic biodiversity in Lake Victoria.	45,000	Jan 2008-Dec 2009
		iii. To contribute to the knowledge base about the underlying causes of changes in biodiversity	45,000	Jan 2008-Dec 2012
		iv. To assess the role of the microbial loop on biodiversity	45,000	Jan 2009-Dec 2011
		v. Others	20,000	
Activity	**7.1.2. To restore sustainable populations of large mammalian herbivores and carnivores in the lake's catchment.**	i. To identify and scale up good practices in community based wildlife management and conservation practices.	70,000	Jan 2008-Dec 2011
		ii. To establish a participatory action process for recovery of populations of threatened species of wildlife.	15,000	Jan 2008-Dec 2012
		iii. Others	10,000	
Activity	**7.1.3. Promote community-**	i. Complete biodiversity inventory of critical wetlands	80,000	Jan 2008-Dec 2009

	public-private sector management and conservation of wetland biodiversity	ii. Enhance the implementation of wetlands management plans for critical areas iii. Enhance community-based interventions for the conservation of wildlife in selected wetlands iv. Promote community-based wetlands management options (e.g. eco-tourism) iv. Others	35,000 57,000 40,000 20,000	Jan 2008-Dec 2012 Jan 2008-Dec 2012 Jan 2008-Dec 2012
Activity	**7.1.4 Review current policies and practices to inform the restoration in degraded rangelands**	i. Research into ways for halting rangeland biodiversity loss and enhancing their restoration ii. Review existing policy on stocking rates and propose ways for alternative management practices iii. Others	49,000 17,000 10,000	Jan 2008-Dec 2012 Jan 2008-Dec 2009
THEMATIC AREA 8	**THEMATIC AREA 8: TRANS-BOUNDARY MANAGEMENT OF COMMON ISSUES**			
	Result area 8.1.	**OVI**	**MOV**	**Assumptions**
	Result area 8.1: Promoting collaborative natural resources management and harmonization of key cross border policies.	i. Conflict management options ii. Strategic management option for the controlling crop and livestock pests and disease iii. Pilots on collaborative cross boarder trade regulation	i. Biodiversity atlas ii. Information on changes in invertebrate diversity	i. Political stability ii. Resources availability iii. Cooperation of stakeholders
	Activity 8.1.1	**Detailed tasks**	**COST**	**Time frame**
	8.1.1. Generate options for	i. Investigate underlying causes of conflicts ii. Develop and pilot conflict management	47,000 45,000	Jan – Dec 2008 Jan 2009-Dec 2010

	conflict management across boarders	options for key conflict areas iii. Others	10,000	
	8.1.2. Developing strategic management options for controlling crop pests and livestock diseases	i. Conduct detailed survey to identify key trans-boundary management issues of major, livestock diseases and crop pests ii. Develop and pilot strategies for controlling of livestock diseases and crop pests iii. Others	45,000 45,000 10,000	Jan 2008-Dec 2009 Jan 2010-Dec 2011
	8.1.3. Develop and promote mechanisms for regulating and coordinating Trans-boundary trade and commerce	i. Examine existing policies and regulations on Trans-boundary trade and commerce ii. Identify and propose areas for revision in the policies, standards and regulations for cross-border trade and commerce iii. Develop and pilot mechanisms for formalizing and regulating cross-border trade and commerce iv. Others	2,000 110,000 20,000 10,000	Jan – Jun 2008 Jun 2008-Dec 2009 Jan - Dec 2010
	Results Area 8.2.	**OVI**	**MOV**	**Assumptions**
Results Area	**Promote Effective Environmental Governance through Institutional Collaboration and Harmonization of Laws and Policies**	i. Harmonized Laws, policies and institutions for environmental governance ii. Improved mechanisms	i. Laws, policies and institutions	ii. Willingness to collaborate amongst partner states iii. Resources availability
	Activity 8.2.1.	**Detailed tasks**	**COST**	**Time frame**
	Generate Strategies for Effective Trans-	i. Investigate the underlying causes of ineffective enforcement of environmental laws and policies	80,000	Jan – Dec 2008

	boundary Environmental Governance	ii. Propose strategies for harmonization of trans-boundary environmental laws iii. Propose options for intervention to ensure effective environmental governance iv. Others	20,000 100,000 33,000	Jan- Dec 2009 Jan 2010-Dec 2011
THEMATIC AREA 9	**THEMATIC AREA 9: *DATA AND DATABASE MANAGEMENT***			
	Result area 9.1.	**OVI**	**MOV**	**Assumptions**
Result Area	**Improved data collection, processing, storage and management**	i. Availability of standard methods for key parameters	i. Standards methods	i. Cooperation amongst stakeholders ii. Resources availability
	Activity	**Detailed tasks**	**COST**	**Time frame**
	9.1.1. To standardize methods for data collection and handling to facilitate networking among key stakeholders	i. To standardize methods for collection of data on key parameters to improve the quality and usability of data through creating metadata ii. Enhance stakeholder capacity (human and infrastructure) iii. Enhance capacity for trend analysis of environmental parameters/systems iv. Others	12,500 12,500 6,510 5,000	Jan – Dec 2008 Jan – Dec 2008 Jan – Dec 2009
	9.1.2. Building capacity for creation and use of GIS database for networking	i. Building institutional capacity (human and infrastructure) ii. Develop a seamless web based GIS database management system iii. Set up user rights for database access iv. Standardize the storage and management of data v. Operationalise systems developed	107,235 619,400 169,400 219,200	Jan – Dec 2008 Jan – Dec 2009 Jan – Dec 2009 Jan – Dec 2009 Jan 2010– Dec 2012

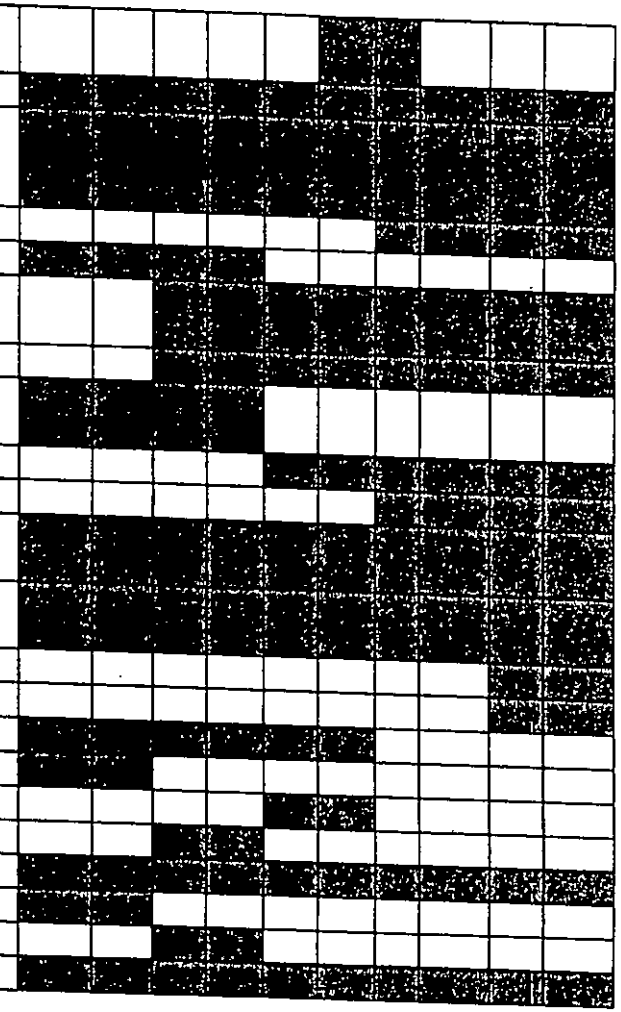
		vi. Others	30,000	

4.5 TIME FRAME FOR IMPLEMENTATION OF THE PROPOSED ARP

Section 4.5. gives the implementation Timeframe for the proposed ARP by thematic areas. In addition, it also presents the main objectives and the detailed tasks/activities under each thematic area. It is proposed that ARP implementation covers a period of 5 years (2008-2012). Some project activities will run for a period of 6 months, while others will cover the whole duration of 5 years.

THEMATIC AREA 1. CAPTURE FISHERIES AND AQUACULTURE

Main Objective	Task/Activity	Year 1		Year 2		Year 3		Year 4		Year 5	
		1	2	1	2	1	2	1	2	1	2
1.1.1.	Assess the extent of the use of illegal fishing gears and methods.										
	Explore options for controlling the use of illegal fishing gears and methods.										
	A review of current institutional mechanisms and arrangements and propose ways of strengthening them.										
	Establish underlying social and economic factors that prevent adherence to policies, regulations and by-laws.										
	Develop options for assessing the effectiveness of control mechanisms of illegal gears and methods on fish stock enhancement										
1.1.2.	To identify critical biodiversity hot spots (e.g. key fish breeding and nursery habitats as well as fish refugia) for protection.										
	To identify and monitor the effects of lake level fluctuations on breeding and nursery of fish biodiversity (especially major commercial fish species).										
	Explore mechanisms for enhancing fish stocks in the main lake.										
	Develop mechanisms for sustainably managing fish stocks in the lake.										
	Develop options for protecting fish breeding grounds										
1.2.1.	Establish the extent and underlying causes of post harvest losses										
	Enhance low-cost technologies and capacity to process and preserve fish										
	Explore options for obtaining credit facilities for artisan fisher folks										

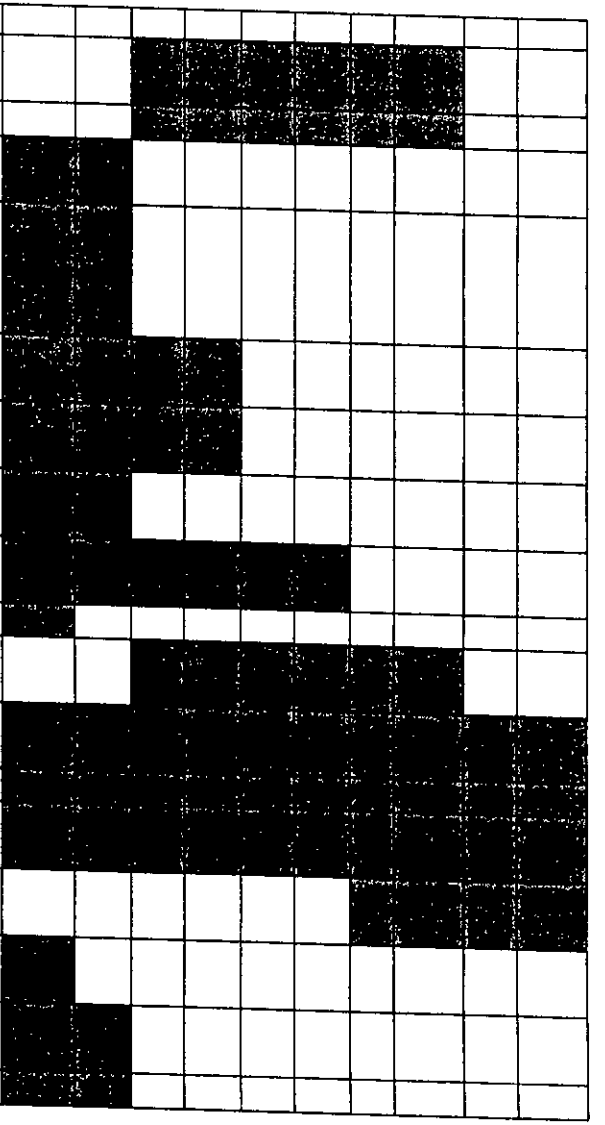
	Explore mechanisms for developing infrastructure for fish handling, transportation, processing and marketing	
	Improve hygiene and sanitation at the landing sites	
1.3.1.	To compile, package and disseminate information on available technologies on pond siting, construction, stocking, and management of appropriate fish species for culturing	
	To explore options for funding to up-scale aquaculture	
1.3.2.	Evaluate the quality of existing aquaculture fish seeds	
	Scale up the use of low-cost technologies in production of high value and good quality aquaculture fish seeds	
	Develop options for adopting new culture species	
1.3.3.	Evaluate existing fish feeds and establish quality appropriate for optimum fish growth.	
	Develop and pilot fish feeds for the various fish species.	
	Promote the use of local ingredients in the production of fish feeds	
1.3.4.	Establish the optimum environmental conditions for the Nile perch fry survival and growth	
	Identify suitable food items for cultured Nile perch & Formulate and evaluate feeds for optimum growth	
	Establish the optimum marketable size of cultured Nile perch	
	Evaluate the cost-effectiveness and market of cultured Nile perch	
1.3.5	Establish environmental conditions for cage culture	
	Evaluate the suitability and profitability of different species for cage culture	
	Identify suitable feeds for cage culture	
	Establish suitability of different sites and cages	
	Establish an environmental monitoring programme	
	Assess the acceptability of cage culture	
	Propose institutional and legal framework for cage culture	
	Identify fish diseases under cage culture and develop preventive measures	

THEMATIC AREA 2. WATER QUALITY AND QUANTITY											
Main Objective	Task/Activity	Year 1		Year 2		Year 3		Year 4		Year 5	
		1	2	1	2	1	2	1	2	1	2
2.1.1	Pilot and scale up the Kirinya Tertiary Municipal Effluent Treatment Pilot Project in the Murchison Bay and Namiiro wetlands										
	Develop effective multi-stakeholder waste (wastewater, solid waste and gas emissions) treatment technologies										
	Build capacity to recycle / reuse waste products by key stakeholders										
	Promote generation of useful by-products (such as biogas and manure) and positive attitudes towards their use										
	Develop strategies for technology transfer										
2.2.1	Assess the quantity and quality of water supplied to selected communities.										
	Examine and recommend important alternative sources of water to the communities.										
	Improve sanitary conditions and reduce waterborne disease prevalence in the selected communities.										
	Develop cheap innovative measures to prevent waterborne diseases.										
	Assess the suitability of Moringa (*Moringa oleifera* Lam) and other cheaper alternatives to purify water at the household level.										
	Scale up Nsumba model village sanitary and hygienic practices.										
2.3.1.	Generate additional data for operationalising the model										
	Develop capacity (human and infrastructure) to run the model										
	Calibrate and test the model										
	Use the LVWQM to predict trends										
2.3.2.	Establish new and utilize existing networks (where they exist) in the catchment for data collection on water quantity										

	Evaluate the relationship between ground water fluctuations and lake levels	
	Assess the contribution of groundwater to lake pollution	
	Collect additional data (including baseflow) for use in updating the model	
	Build capacity (human & infrastructural)	
	Update the model to predict trends in water quantity (inflows and outflows)	
	Analyze trends in the flow quantities, rainfall and evaporation in order to manage the lake basing on the dynamics of the regime.	
	Evaluate the current Water Release Policy and propose a new one	
	Develop a Water Discharge Support System.	
2.4.1.	Establish the number of littoral and pelagic stations required for monitoring the rates of siltation and sedimentation	
	Generate baseline data on the rates of sedimentation and siltation	
	Establish a monitoring programme	
	Generate data on the chemistry of the sediments at different depths	
	Generate data to assess climatic changes	
	Generate data to contribute to the bathymetric map of Lake Victoria	

THEMATIC AREA 3. ATMOSPHERIC DEPOSITION OF NUTRIENTS											
		Year 1		Year 2		Year 3		Year 4		Year 5	
Main Objective	Task/Activity	1	2	1	2	1	2	1	2	1	2
3.1.1	Assess the contribution of atmospheric pollutants (including nutrient depositions) on Lake Victoria.										
	Determine the sources, quantities, and routes of atmospheric pollutants entering the lake.										
	Determine necessary actions to control and address the impairment caused by atmospheric pollutant depositions										

THEMATIC AREA 4. CATCHMENT MANAGEMENT											
		Year 1		Year 2		Year 3		Year 4		Year 5	
Main	Task/Activity	1	2	1	2	1	2	1	2	1	2

Objective		
4.1.1	Determine the magnitude, effects and monetary value of rangeland and forest degradation	
	Develop and upscale viable management options for rangelands and forests	
	Build capacity and systems for multi-stakeholder management of rangeland and forestry resources	
4.1.2.	Identify and upscale economically viable farming practices (building on LVEMP 1 and other pilot studies in the region) e.g. integrated soil fertility and water management, water harvesting, integrated pest management, agro-forestry and crop livestock integration)	
	Build capacity of farmers and service providers in support of improved farming practices	
	Strengthen local institutions (e.g. local leaders, CBOs, women groups) for monitoring and enhancing adoption of improved farming practices	
4.1.3.	Promotion of community participation in the management and restoration of selected wetlands in the catchment	
	Generation of management options for enhancing biodiversity and buffering capacity of the selected wetlands	
4.1.4.	Assess the importance of siltation and sedimentation in the Bukora catchment	
	Develop and pilot mechanisms for monitoring siltation and sedimentation of water bodies in the catchment	
4.2.1.	Study the impact of agrochemicals on the food chain and propose options for remedial measures	
	Assess the impacts of agrochemicals on human health including occupational	
	Study the impact of the use of DDT to fight malaria on the environment and public health	
	Update the database of possible sources of contaminants and map out hot spots (e.g. flower gardens)	
4.2.2.	Review, develop and strengthen basin-wide policies, institutions and practices on use of key persistent chemicals with residual pollution effects	
	Explore mechanisms to strengthen existing monitoring institutions e.g. Agrochemicals Control Board	
	Propose appropriate ways to promote research-based policy formulation	

THEMATIC AREA 5. AQUATIC WEEDS											
Main Objective	Task/Activity	Year 1		Year 2		Year 3		Year 4		Year 5	
		1	2	1	2	1	2	1	2	1	2
5.1.1	Identify and implement effective and sustainable regional management options for water hyacinth in River Kagera										
	Mitigate weed biomass flow into Lake Victoria										
5.1.2.	Research into factors (e.g. environmental, social, economic) sustaining resurgence of water hyacinth										
	Identify and pilot options for effective control of water hyacinth										
5.1.3	Establish factors (e.g. environmental, social, economic) driving proliferation of native water plants to weed status										
	Investigate the environmental and socio-economic impacts of proliferation of native water plants										
	Research, enhance and pilot options for native weeds control										
5.2.1	Identify parameters necessary for developing early warning mechanisms (monitoring networks and facilities for data gathering, processing and sharing)										
	Establish a centralized database										
	Develop and pilot early warning mechanism										

THEMATIC AREA 6: SOCIO-ECONOMICS AND PRIVATE DEVELOPMENT											
Main Objective	Task/Activity	Year 1		Year 2		Year 3		Year 4		Year 5	
		1	2	1	2	1	2	1	2	1	2
6.1.1	Investigate the underlying causes of the high prevalence of the communicable and vector borne diseases										
	Examine and evaluate past community participatory interventions in water quality, quantity, supply and sanitation management										
	Evaluate behavioral change interventions to mitigate communicable and vector borne diseases										
	Assess options for establishing monitoring mechanisms for tracking communicable and vector borne diseases among transient populations.										
	Explore the use of traditional medicine in the treatment of communicable and vector borne diseases										
6.1.2	Evaluate good practices (environmentally friendly strategies) for household waste management										
	Examine existing appropriate technologies (e.g. energy saving technologies, alternative to natural resources such as building materials, packaging materials) for purposes of scaling up										
	Research into ways of attracting/ interesting the Private Sector into Natural Resources Research										
	Assess the profitability of prospective enterprises (e.g. aquaculture, water harvesting & storage, post-harvest handling and value addition) that improve livelihoods										
	Explore options for linking natural resources users to markets to increase net returns to households										

	Explore alternative and viable investments for fisher folks & Evaluate the user-friendliness of existing micro-finance services for producer communities	
6.2.1	Evaluate past interventions in demand-driven research-extension for purposes of identifying good practices for linking farmers to markets and farm inputs (e.g. contract farming for sugar companies)	
	Research into use & adoption of appropriate yield boost strategies (e.g. fish feeds, crop and livestock production technologies, soil fertility enhancement options, quality control and management)	
	Boost local community incomes through sustainable use and management of natural resources	
	Assess capacity of farmers to participate in market driven production	
	Assess the impact of land use policies and practices on private sector investment	
6.2.2	Assess the performance of existing ecotourism projects	
	Assess the potential of other tourist destinations for piloting	
	Explore options for community participation in management and sharing of benefits with private sector agencies	
	Examine options for joint development of tourism sites by interested stakeholders (geo-tourism, cultural tourism)	
	Assess capacity of local communities and private sector for participating in tourism projects	

THEMATIC AREA 7: BIODIVERSITY											
Main Objective	Task/Activity	Year 1		Year 2		Year 3		Year 4		Year 5	
		1	2	1	2	1	2	1	2	1	2
7.1.1	Inventory the status of aquatic biodiversity (e.g. fish species, mammals, herpetiles) in satellite lakes of the basin.										
	Complete mapping of the distribution of aquatic biodiversity in Lake Victoria										
	To contribute to the knowledge base about the underlying causes of changes in biodiversity										
	To assess the role of the microbial loop on biodiversity										
7.1.2.	To identify and scale up good practices in community based wildlife management and conservation practices.										
	To establish a participatory action process for recovery of populations of threatened species of wildlife										
7.1.3.	Complete biodiversity inventory of critical wetlands										
	Enhance the implementation of wetlands management plans for critical areas										
	Enhance community-based interventions for the conservation of wildlife in selected wetlands										
	Promote community-based wetlands management options (e.g. eco-tourism)										
7.1.4	Research into ways for halting rangeland biodiversity loss and enhancing their restoration										
	Review existing policy on stocking rates and propose ways for alternative management practices										

THEMATIC AREA 8: TRANS-BOUNDARY MANAGEMENT OF COMMON ISSUES											
Main Objective	Task/Activity	Year 1		Year 2		Year 3		Year 4		Year 5	
		1	2	1	2	1	2	1	2	1	2
8.1.1	Investigate underlying causes of conflicts										
	Develop and pilot conflict management options for key conflict areas										
8.1.2	Conduct detailed survey to identify key trans-boundary management issues of major, livestock diseases and crop pests										
	Develop and pilot strategies for controlling of livestock diseases and crop pests										
8.1.3	Examine existing policies and regulations on Trans-boundary trade and commerce										
	Identify and propose areas for revision in the policies, standards and regulations for cross-border trade and commerce										
	Develop and pilot mechanisms for formalizing and regulating cross-border trade and commerce										
8.2.1.	Investigate the underlying causes of ineffective enforcement of environmental laws and policies										
	Propose strategies for harmonization of trans-boundary environmental laws										
	Propose options for intervention to ensure effective environmental governance										

THEMATIC AREA 9: *DATA AND DATABASE MANAGEMENT*											
Main Objective	Task/Activity	Year 1		Year 2		Year 3		Year 4		Year 5	
		1	2	1	2	1	2	1	2	1	2

9.1.1.	To standardize methods for collection of data on key parameters to improve the quality and usability of data through creating metadata										
	Enhance stakeholder capacity (human and infrastructure)										
	Enhance capacity for trend analysis of environmental parameters/systems										
9.1.2.	Building institutional capacity (human and infrastructure)										
	Develop a seamless web based GIS database management system										
	Set up user rights for database access										
	Standardize the storage and management of data										
	Operationalise system developed										

4.6 CAPACITY BUILDING FOR APPLIED RESEARCH

Effective implementation of the ARP will require efficient capacity in both human and infrastructure / equipments. Interventions where necessary will include the following as presented in Table 3.

Table 3. Thematic Areas and Capacity Interventions

S/No.	Thematic Area	Capacity Interventions
1	Capture fisheries and Aquaculture	i. Human: Awareness (local communities, like BMUs; and other stakeholders), training (short courses, MSc, PhD) ii. Equipment: Various iii. Facilities: infrastructure development/improvement, transport (land and water
2	Water quality and Quantity	i. Wastewater ponds rehabilitation (NWSC) ii. Pipes for wastewater treatment iii. Human capacity to run Tertiary wastewater treatment pilots iv. Training in biogas technology v. Training in recycling and reuse of waste products vi. Training managers in water quality and quantity modeling vii. Hardware and software for modeling viii. Sediment corers, sediment traps ix. Sensitization workshops
3	Atmospheric deposition	i. New monitoring stations ii. Capacity building (2 MSc. students) iii. Sensitization workshops
4	Catchment Management	i. Sensitization workshops ii. Sediment corers, sediment traps
5	Aquatic Weeds	i. Human: Training (MSc) in development and management of Early Warning System for water hyacinth and other invasive weeds. ii. Equipment: Various iii. Facilities: infrastructure development/improvement, transport (land and water)
6	Socio-economics and Private Sector	i. Training relevant stakeholders ii. Sediment corers, sediment traps
7	Biodiversity	i. Sensitization workshops
8	Management of Transboundary Issues	i. Sensitization workshops
9	Data and Database Management	i. Hardware and software ii. Human capacity training

CHAPTER FIVE

5 PROPOSED MONITORING PROGRAMME UNDER LVEMP II

Interventions in LVEMP II will need to be monitored and evaluated. For this to be achieved, a number of parameters will be monitored. Table 4. presents some of the parameter and key institutions that will be involved in the routine monitoring programme or framework. The Monitoring and Evaluation Component of LVEMP II will take the lead responsibility in preparing the monitoring framework. The proposed lead institutions for undertaking the monitoring programme are presented in bold in Table 4.

Table 4. Proposed monitoring programme under LVEMP II

Parameters	Key Institutions
Water quality i. pH ii. Dissolved oxygen (DO) iii. Temperature iv. Transparency v. Turbidity vi. Suspended Solids vii. Colour viii. Salinity ix. Conductivity x. Biochemical Oxygen Demand (BOD) xi. Chemical Oxygen Demand (COD) xii. Total Nitrogen xiii. Total Phosphorus and Phosphates xiv. Ammonia xv. Odour and Taste xvi. Oil contents (N-hexane Extracts) xvii. Others	MoH, MAAIF, **DWD**, NWSC, NAFIRRI, GAL, Department of Zoology (MAK) & Private Sector, Academic Institutions
Heavy / toxic metals	MoH, **DWD**, NAFIRRI, Department of

i. Cadmium (Cd) ii. Zinc (Zn) iii. Lead (Pb iv. Mercury (Hg v. Arsenic (As) vi. Chromium (Cr) vii. Selenium (Se) viii. Manganese (Mn) ix. Others	Geology (MAK) & Private Sector, Academic Institutions
Pesticide residues and public health drugs i. DDT ii. Lindane iii. Aldrin iv. Dieldrin v. Endosulfan vi. Polychlorinated biphenyls (PCBs) vii. Others	MoH, DWD, NAFIRRI, **KARI** Department of Chemistry (MAK) & Private Sector, Academic Institutions
Biological parameters i. Phytoplankton ii. Chlorophyll a iii. Zooplankton iv. Benthic macro-invertebrates v. Fish vi. Bacteriological contamination vii. Coliform bacteria viii. Macrophytes ix. Others	MoH, MWE, **NAFIRRI**, Department of Zoology (MAK) & Private Sector, Academic Institutions
Sedimentation and siltation i. Sedimentation and siltation rates ii. Physico-chemical and micro(biological) characteristics iii. Reduction in water depth / level iv. Bathymetric measurements/mapping v. Benthic properties	**DWD, KARI**, Department of Geology (MAK) & Private Sector, Academic Institutions

Water levels / quantity vi. Lake water levels vii. Groundwater levels viii. River discharges ix. Lake water flows x. Evapo-transpiration xi. Precipitation xii. Others	**WRDM, DWD** & Private Sector, Academic Institutions
Industrial and Municipal waste management i. Number of industries discharging ii. Pollution loading iii. Settlements iv. Others	**NWSC**, DWD, Private Sector, Academic Institutions
Biodiversity loss i. Type and number of species disappearing ii. Fertility, Mortality, Death and immigration rates iii. Others	**NAFIRRI**, NEMA, WID, Department of Zoology (MAK), MUIENR, Private Sector, Academic Institutions
Wetland degradation i. Location and coverage ii. Number of species present by type iii. Functions and values iv. Physical, chemical and microbiological v. Products extracted vi. % of wetlands with sustainable management plan vii. Others	**WID**, NEMA, Department of Zoology (MAK), MUIENR & Private Sector, Academic Institutions
Deforestation i. Forests cover ii. Price of forest products iii. Others	MAAIF, **MWE**, Faculty of Forestry and Nature conservation (MAK), NFA & Private Sector, Academic Institutions
Aquaculture i. Fish seeds ii. Fish feeds iii. Income from pond and cage culture	MAAIF, **NAFIRRI, Kajjansi,** Department of Zoology and Faculties of Agriculture & Veterinary Medicine (MAK) & Private Sector, Academic

iv. Pond management v. Tonnage of fish harvested from ponds vi. Others	Institutions
Fisheries Research i. Reduction in fish species diversity ii. Loss of biodiversity iii. Infestation by water weeds iv. Fish catch v. Fish stocks vi. No. of fish factories vii. Others	MAAIF, **NAFFIRI**, LVFO, Department of Zoology (MAK) & Private Sector, Academic Institutions
Fisheries Management i. Quality of fish and products ii. Fisheries co-management iii. Fish catch iv. Fish stocks v. BMU committee meetings vi. All fisheries stakeholders listed in BMU register with gender balance vii. Percentage reduction in number of illegal fishing boats and gears viii. Percentage increase in fish catch per year ix. Percentage increase in income of fishers per year x. Others	**MAAIF**, Ministry of Labour, Gender and Social Development, NEMA, Department of Zoology (MAK), NAFFIRI, LVFO, BMUs, UBOS & Private Sector, Academic Institutions
Aquatic weeds i. Rate of deposition / accumulation / speed ii. Coverage area iii. Re-emergence iv. Discharge from R. Kagera v. Weevil rearing centers vi. Prevalence of vector-borne diseases vii. Others	MAAIF, MoH, WRMD, **NAFIRRI**, Department of Zoology (MAK), MUIENR & Private Sector, Academic Institutions
Socio-economic and Private sector development	UBOS, MAAIF, MoH, Min of Education,

i. Market based research (e.g. accessibility and trade) ii. Health/diseases prevalence iii. Population dynamics – birth rates, mortality, migration into the Lake Basin urban centres settlement trends, population density changes and trends iv. Percentage of children with diarrheal diseases v. Percentage of households with access to safe water resources vi. Number of solid wastes dumping sites vii. Income levels – poverty rates viii. Agricultural activities – crops and livestock ix. Investments and investment opportunities x. Education trends – trends of literacy, school enrolment, xi. Health indices – disease prevalence, HIV/AIDS trends and impacts xii. Informal sector growth and development xiii. Role of financial institutions in poverty alleviation xiv. Credit facilities to women and local investments xv. Human-wildlife conflicts – e.g., hippos and crocodile versus lake users xvi. Assessment of environmental awareness among key informants e.g. in grassroots leaders in provincial administration so that information dissemination programmes can be planned effectively. xvii. Women's socio-economic needs should be identified and monitored to identify areas for intervention xviii. Supply of clean water to the communities in the basin xix. Others	**MWE**, Makerere University Institute of Social Research (MISR), Department of Zoology (MAK), MUIENR & Private Sector, Academic Institutions

Under-employment and unemployment i. Crime rates ii. Labour market trend analysis iii. Employment rate by gender iv. Inadequate service delivery facilities v. Number of school drop outs vi. Examination results vii. Number of health units viii. Length and conditions of access roads ix. Proportion of house holds with access to facilities x. Household perception of facilities xi. Others	**UBOS**, MoH, MoTTI, Makerere University Institute of Social Research (MISR), Ministry of Internal Affairs, Department of Zoology (MAK) & Private Sector, Academic Institutions
Conflicts in Natural Resources Use i. Number of violent incidences reported ii. Number of people of people displaced by conflicts iii. Number of conflict related deaths iv. Others	UBOS, MoH, MoTTI, **Makerere University Institute of Social Research (MISR)**, Ministry of Internal Affairs & Private Sector, Academic Institutions

CHAPTER SIX

6 PROPOSED IMPLEMENTATION FRAMEWORK FOR APPLIED RESEARCH PROGRAMME

Under LVEMP I, little integrated research was carried out. For the applied research programme, we propose an interdisciplinary and multidisciplinary research effort. We also propose close collaboration between research institutions, government departments and other line ministries of water, lands, and the environment in the riparian states.

APPLIED RESEARCH AREAS	*RESEARCH INSTITUTIONS AND AFFILIATED INSTITUTIONS							
	Universities	Fisheries Research Institutions	Agricultural Research Institutions	Medical Research Institutions	Forestry /Wildlife Departments	Industrial/ Municipal Wastes Institutions	Water Quality/ Quantity Institutions	Wetlands Departments
Fish biodiversity								
Fish stock assessments								
Lake/capture fisheries								
Aquaculture								
Fisheries socioeconomics								
Wetlands								
Pests and water related								

diseases	
HIV/AIDS	
**Capacity building	
Impact of fisheries exploitation on national economies, rural communities and the environment	
Land use impacts on lake ecosystem (sedimentation, soil erosion, deforestation)	
Fish quality assurance	
Water quality assurance	
Local technology for water treatment	
Aquatic Weeds	
Pollution by agricultural, mining and industrial activities	

Conflicts in resources use (e.g. bush fires)				
Atmospheric Deposition				

*The list of research institutions presented here is not necessarily exhaustive.
** Capacity building will be developed for local and other stakeholder communities to sustainably manage lake resources. Also, human and infrastructural capacity will be built for the different institutions to research, manage and foster sustainable economic development in the Lake Victoria basin. Special emphasis will be put on women since they constitute a major group of people carrying out various tasks in the Lake Victoria basin.

Policy and Research Institutions

Policy and Research Institutions in the identified key Research Areas for implementing the proposed ARP is presented in Table 5.

Table 5. Policy Formulating, Coordinating and Research Institutions in Uganda

S.N.	Thematic Area	Policy Formulating and Coordinating Institutions	Research Institutions
1	Capture Fisheries	MAAIF (Department of Fisheries Resources)	NAFIRRI, Mak
	Aquaculture	MAAIF (Department of Fisheries Resources)	NAFIRRI (Kajjansi), MISR, Mak, Local Government, Private Sector
2	Water Quality and Quantity	MWE (WRMD, DWD), NEMA	NAFIRRI, WRMD, DWD, Mak, Local Government, Department of Meteorology, UNBS, Private Sector
3	Atmospheric Nutrients Deposition	MAAIF, MWE (WRMD, DWD), NEMA	KARI, WRMD, DWD, Mak
4	Catchment Management	MAAIF, MWE (WRMD, DWD), NEMA	MoTTI, KARI, NFA, WID, DWD, UWA, Mak
5	Aquatic Weeds	MAAIF, MWE (WRMD, DWD), NEMA	WRMD, DWD, NEMA, NAFIRRI, KARI, Mak,
6	Socio-	MFPED, MAAIF, MoTTI, MWE,	MISR, UIA,

	economics and private Sector development		
7	Biodiversity	MAAIF, MWE, Ministry Lands and Urban Development, Ministry of East African Cooperation	NAFIRRI, WID, UWA, DWD, NFA, NGOs/CBOs, Mak
8	Management of Trans-Boundary Issues	MAAIF, MWE, Ministry Lands and Urban Development, Ministry of Justice and Constitutional Affairs	NAFIRRI, WID, UWA, DWD, NFA, NGOs/CBOs, Mak
9	Data and Database Management	Ministry of ICT, MAAIF, MWE	NFA, WRMD, DWD, KARI, NAFIRRI, Mak

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APPENDIX I. DESCRIPTION OF SERVICES

CONSULTANCY FOR SERVICES FOR APPLIED RESEARCH PROGRAMME

1.0 Background

Lake Victoria is Africa's largest and the world's second largest freshwater lake. It is one of the most important shared natural resources of Eastern Africa. It straddles across the common boarders of the three East African Community Partner States of Kenya, Tanzania and Uganda, and features the world's largest freshwater fishery with significant local consumption and exports, in particular to the European Union, and it is a global center of aquatic biodiversity. The Lake and its catchment form a Basin that is valued for its socio-economic potential in addition to its immense ecological values. The economic

potential of the catchment is based on the rich agricultural soils, abundant rainfall, and significant minerals deposits, among others. The Lake, on the other hand, is one of the unifying factors for the three Partner States in addition to having a critical importance to the region's society and economy as a source of food, potable water, transportation, agricultural water, power production and tourism.

The lakeshore populations are the most rapidly growing geographic sectors in countries that have among the highest population growth rates in the world. The lake, the lakeshore and the lake basin are obvious engines of economic growth in countries where poverty alleviation of high priority.

The lake has experienced a decline in water quality since the 1960's. Phosphorus concentrations and algal biomasses have increased significantly, and filamentous and colonial blue-green algae now dominate the algal community. Water hyacinth invaded the lake, and in the mid- to late 1990s reduced the efficiency of operation of the Owen Falls hydroelectric plant and blocked access to ports, fish landings and watering points. The water quality changes favored the success of the Nile perch and contributed to the reduction of endemic fish species.

Joint management of the Lake Victoria and its Basin as a shared ecosystem gained momentum following conclusion of the Rio Earth Summit in 1992. The Lake Victoria Environmental Management Project (LVEMP) was prepared and implemented from 1994 as part of this initiative. In 2001 the Lake Victoria Development Programme (LVDP) at the EAC Secretariat and more recently the development of a Protocol for sustainable management of Lake Victoria Basin which provides both for the detailed legal framework and a Lake Victoria Commission as a body for the regional management of the entire basin.

LVEMP-1 and other bilateral efforts, have developed significant knowledge and technical capacity in the national agencies to enable assessment of the environmental stresses confronting the lake and its catchment. Additional research on key issues is needed, on the basis of which one can prioritize actions and set objectives for management of the lake and its resources. This should be done in a participatory manner in which local community interests and concerns are appropriately reflected. In many cases final objective setting will require agreement of the other riparian states and the endorsement by EAC via its Secretariat. The successful setting of objectives for water quality management requires a broad vision of what the riparian peoples desire for Lake Victoria in the future. This will require blending individual sector knowledge and visions for their resource with the more general and integrative interests of the communities that enjoy and require beneficial uses of the lake and its tributary waters.

Implementation of the LVEMP-1 has resulted in improved ability in the riparian States to embark on a long-term program of resource management and environmental improvement (such as capacity building). Some of the achievements of LVEMP include: establishing and supporting fisheries "co-management units" with local fishing beach communities in over 800 sites around Lake Victoria; Obtaining an estimated 80-90 percent reduction in surface coverage of water hyacinth in the Lake through central and village-level biological agent rearing and mechanical/manual means, thus reducing water hyacinth to non-nuisance levels except in some hotspots including inflow from the Kagera river; Undertaking a "whole Lake" fishing pressure survey; Undertaking a harmonized "whole Lake" water quality/limnology survey; Undertaking three multi-

sectoral management pilots (one in each country) of important micro-catchments in the Lake Victoria Basin. These involved the soil conservation, catchment afforestation, wetlands management, micro-projects, and water quality components of the project working together to improve river/Lake water quality; and assisting the three governments to meet European Union requirements to improve beach sanitation and export certification of fish shipped to European Markets.

As a result of the establishment of East African Community and subsequent materialization of an East African Development Strategy (2001-2005) designated LVB as a regional economic growth zone. The identification of Lake Victoria Environmental Management Project phase two (LVEMP-2) was done through a process involving review of performance of Lake Victoria Environmental Management Project phase one and development of a Vision and Strategy Framework for management and development of Lake Victoria Basin. The above processes culminated into a Regional Stakeholders Concept Workshop, which identified the priority areas of focus for LVEMP-2 as, Socio-economic Development, Management and Research. The next step is to develop intervention that uses the information and capacity developed to promote environmentally and socially sustainable economic development.

The applied research program will generate relevant environmental, social, and economic related findings and outcomes for application by the private & public sector in achieving the Development Objective

2.0 Objective of the consultancy

The objective of the consultancy is to identify key activities for the Applied Research Program in natural resources, environment, socio-economic sectors and transboundary issues.

The specific objectives are:

i) Summarize environmental, social and economic related findings and outcome for application by the riparian communities, public and private sector.
ii) Identify gaps in the research agenda;
iii) Prepare a prioritized and costed applied research program to be implemented at both national and regional level;
iv) Prepare detailed research proposal on atmospheric deposition with emphasis on phosphorous

3.0 Issues

The Applied Research Program will focus on research issues that will strengthen the following areas:

3.1 Economic growth and private sector and environmentally friendly market driven development focusing on areas such as:

i) Sustainable and environmentally appropriate technologies

ii) Investing in R & D, focusing in enterprises where the Basin has a comparative advantage and performed by selected Centers of Excellence and network of researchers and scientists.
iii) Developing appropriate yield boost and post harvest technologies for adoption by farmers.
iv) Spearheading a demand driven research-extension system, where private sector is encouraged to take a leading role.
v) Developing cost-effective water harvesting for livestock use and crop irrigation.
vi) Building the capacity of rural communities to mobilize savings and build micro-finance institutions.
vii)
viii) Impact of fish industry to the environment, social amenities of lakeside communities and distribution of fisheries to the three national economies.
ix) Consequences of changes in fishing policies and landuse.
x) Impacts of introducing low cost technology for treatment of both municipal and industrial effluent.
xi) Developing technologies that empower women to conserve and manage natural resources for economic growth.

3.2 Trans boundary Natural Resources Regional Management

This will involve the assessment of trans boundary issues within the lake Basin including Rwanda and Burundi to be addressed under the applied Research Program among them:

i) Fisheries (Effects of fish biodiversity loss, and threat to the endangered and vulnerable species, Effects of over fishing of key commercial species and non-optimal harvesting of living resources);
ii) Water hyacinth (Effects of resurgence of water hyacinth, effects of existence of water hyacinth hot spots related to socio-economic activities in the lake);
iii) Pollution caused by nutrients such as Nitrogen and Phosphorus, impacts on algal growth and toxicity of algae to fish and human beings;
iv) Effects of mercury, oils spills, agrochemicals and other chemicals on food web structure, system productivity and lake environment;
v) Biological Oxygen Demand (Effects of Oxygen depletion);
vi) Land use and sedimentation (effects of deforestation, unsustainable land use practices, agriculture, overgrazing, Effects of soil erosion and Uncertainty regarding ecosystem status and yields in a varied environment);
vii) Water Quality and Quantity (Impacts of increased coliform, faecal and bacterial counts);
viii) Conflict in resource use (cattle rustling, cross border fishing conflicts, Water use, Wetland degradation, Forest destruction, Wildlife migration, Bush fires); and
ix) Pest and diseases (Impacts of HIV/AIDS, Outbreak of diseases, Migratory pests).

3.3 Natural Sciences including:

i) Fisheries research- this will focus taxonomy of lake fishes, genetic diversity, fish biology, fish quality and safety, limnology and monitoring;

ii) Water research – this will encompass water quality, quantity, hydrodynamic and modeling, eutrophication, pollution loading, water chemistry, sedimentation, water catchment management and monitoring;
iii) Research role on atmospheric deposition of phosphorous and meteorology; and
iv) Research on aquatic weeds including water hyacinth.

4.0 Tasks/Activities

The consultant will be expected undertake the following tasks:

i) Review research information available from previous interventions including LVEMP, Kagera River Basin Integrated Water Resources Management Project, Mara River Basin Integrated Water Resources Management Project, Sio, Malaba-Malakisi River Basin Integrated Water Resources Management Project and other sources to establish nature of problems, extent and geographic location of key research issues;
ii) Review past and ongoing research and identify gaps which needs to be filled in research issues, problems, their causes, impacts, socio-economic consequences and the perceived solutions;
iii) Propose a prioritized applied research program agenda to generate relevant environment, social and economic related findings and outcomes for application by private/public sector with emphasis on environmentally friendly market driven development, Transboundary natural resources regional management and Natural sciences;
iv) Assess and propose targeted research capacity building with view a to developing predictive scientific capacity that will require greater application of models and database management;
v) Review existing research outputs on atmospheric deposition with emphasis on phosphorus with a view to proposing further research;
vi) Review information available from Transboundary Diagnostic Analysis (TDA) and Strategic Action Plan (SAP) reports with a view to developing a proposal for implementation by the applied research component;
vii) Collate the information from national consultancies and organize a regional stakeholders' workshop to create consensus on the applied research agenda at the regional level; and
viii) Propose an implementation framework for the Applied Research programme
ix) Prepare a final and a prioritized research program which should include a clear logical framework and detailed budget

5.0 Methodology

The tasks will be carried out in close collaboration with the client. The consultancy will be done in two stages: an inception phase and the main stage.

During the inception stage, the consultant will:

(a) Carry out a preliminary assessment of available data by doing desk reviews on existing empirical and situational literature and case studies.
(b) Carry out preliminary field visits to key stakeholders, projects and programmes relevant to the assignment;
(c) Produce an inception report.

The purpose of the inception report will be threefold:

(a) To test the understanding of the terms of reference by the consultant;
(b) To state clearly how the consultancy will be carried out, in terms of both the methodology and timelines, as well as the anticipated limitations/constraints; and
(c) To state the progress which will have been made and problems/challenges if any.

During the main stage (following clearance of the inception report through a workshop/meeting) the consultant will:

(a) Use appropriate approaches for the study, including baseline surveys, focus group discussions, stakeholders' workshops, data collection, coding, analysis and interpretation of the key findings. This will include reviews to analyze all available data in LVEMP, stakeholders and other sources;
(b) Establish the cause-effect relationships underlying identified problems;
(c) Identify long-term measures to address the problems;
(d) Produce the *Draft* Final Report;
(e) Organize a Regional Workshop for consideration of the *Draft* Final Report; and
(f) Incorporation of comments to produce and submit a Final Report.

The consultant will collaborate closely with the National Secretariat and liaise with consultants from the other partner states to consolidate the National Reports into a Regional Report led by Uganda.

The time schedule for key staff and Activity schedule is attached.

6.0 Outputs from the consultant

The outputs shall be:

i) Inception Report
ii) Mid Term Report
iii) Draft final Report
iv) Final Report

The draft final and final reports shall be done using the logical framework approach with components well defined in terms of objectives, outputs, impacts (outcomes), activities, indicators and costs as an input to the final project design. The report will further provide information on assessing and proposing target research capacity building and a detailed research proposal on atmospheric phosphorous.

The final report will be submitted in both hard and soft copies.

APPENDIX II. SUMMARY OF KEY RESEARCH INTERVENTIONS IN THE LAKE VICTORIA BASIN

Capture fisheries

Lake Victoria had a multi-species fishery dominated until the 1970s by the tilapiines and haplochromine cichlids, but with important subsidiary fisheries of more than 20 genera of

non-cichlid fishes such as *Bagrus, Barbus, Clarias, Mormyrus, Protopterus, Synodontis*, etc. During the last 30 years, changes (physical, chemical and biological0 have occurred in Lake Victoria and, consequently, the fish stocks have been modified. The extent of the modification of the fish stocks is not fully known.

The most important fisheries independent survey programme that has taken place on Lake Victoria was the intensive trawl surveys. The main aim of this activity was to assess the structure and dynamics of the fish stocks.

The first lake-wide fish stock assessment trawl survey was undertaken by the FAO/UNDP/EAFFRO during the period 1969/71 (Kudhongania and Cordone, 1974). This survey reported the dominance of Haplochromis spp, contributing about 83% of the biomass. Subsequent surveys in the northern portion of Lake Victoria, during the period 1881/85 indicated the establishment of the introduced Nile perch (*Lates niloticus*) whose contribution increased from less than 0.1% (by weight) during 1969/71 to about 96% in 1985. The Haplochromis spp contribution declined to about 1% in 1985.

The other trawl surveys that have been carried out in the Uganda sector of Lake Victoria included the 1993/95, 1997/2000 LVFRP/FIRI survey and the IFMP/FIRRI survey of 2003/2005. These surveys were aimed at assessing the structure and dynamics of the Nile perch and, to some extent, the tilapia and haplochromine fish stocks of the lake. The findings included the following:

Over 20 fish taxa (excluding the Haplochromis complex), belonging to 16 genera, were encountered during the FAO/UNDP/EAFFRO bottom trawl survey conducted on Lake Victoria during 1969/71.

The fish species composition in the bottom trawl surveys, in the Uganda part of Lake Victoria, has declined to 16 fish taxa (14 genera) during the 1997/2000 and 7 fish taxa (6 genera) in March 2005.

i. The haplochromine dominated the fishery during the 1969/71 survey, contributing 83% of the fish biomass; this dominance of the haplochromine declined to 2.1% (by weight) in 1985 and its contribution to bottom trawl catches was estimated as 5.3% in March 2005.
ii. The introduced *Lates niloticus*, which contributed less than 0.1% of the bottom trawl biomass during 1969/71, became established and increasingly dominated the Lake Victoria fishery; its contribution increased to 96.7% (by weight) during 1993/95 and currently (March 2005) contributes 74% of the biomass.
iii. The contribution of *Oreochromis niloticus*, an introduced species, has increased from less than 1% during 1969/71 to 12% in 2000 and 16.7% in March 2005.
iv. The mean catch rates for *L. niloticus*, during the bottom trawl surveys in the Ugandan part of Lake Victoria, increased from about 0.04±0.0 t in 1969/71 to 12.00±1.1 t in 1999, declined to 3.60±1.0 t in 2003, then increased to 7.20±1.2 t in March 2005. The mean catches of *O. niloticus* also increased from 0.15±0.0 t during 1969/71 to 1.61±0.2 t in March 2005.

Aquaculture

The main objective for aquaculture introduction in Uganda was to reduce malnutrition by improving the supply of animal proteins, especially among the rural population. Several survey reports since 1927 up today have always revealed high levels of malnutrition among Uganda's population. Proteins deficiency (Kwashiorkor) was evident particularly in central and western regions. For a long time, proteins intake in most parts of Uganda has been less than 60% of animal proteins requirements, especially in rural areas. Fish farming was therefore introduced at subsistence level especially in areas that are far off the main natural waters of the country to enable people improve on their nutrition and diets. Realizing profit from aquaculture was not the objective of introducing aquaculture in Uganda.

The potential for development and success in the aquaculture Uganda is high. This is because the country is endowed with a lot of natural resources that are necessary for aquaculture practice. These include natural waters e.g. lakes, rivers, streams, wells and wetlands. These natural water bodies are relatively clean and unpolluted. All these are suitable for the culture of fish in different set ups, for example fish ponds, raceways and cage culturing. The country is also blessed with suitable climatic conditions and weather. For example, most parts of Uganda experience temperature between 25-28°C for all months annually. In addition, a lot of land and suitable soils are also available in the country that can be utilized for aquaculture. The country is endowed with soils that are not very sandy and are able to hold water in dug out ponds. On average, we can realize about 6-10 tons of fish from a hectare of land.

Until recently, fish has been the cheapest source of animal protein to a section of the human population in the Lake Victoria basin. The annual per capita consumption of fish in Uganda is 10 kg, contributing more than 50% of animal protein intake of an average Ugandan diet. In order to maintain the present per capita fish consumption levels of around 10 kg per year by the year 2015 when Uganda population of 32 million Ugandans is forecast, 320 000 tonnes of fish will be required. Besides, Uganda has an annual recommended maximum fish export allowable of 60 000 tonnes (Uganda Fisheries Resources Department, 2004). Uganda, therefore, needs to develop capacity to produce at least 380 000 tonnes of fish to meet her domestic consumption needs and export requirement. This implies invariably that an increase of 160 000 tonnes in fish production over and above the 2001-catch level of 220 726 tonnes will be necessary by the year 2015. Such an increase in the production of food fish is considered feasible if aquaculture or fish farming production is dramatically increased in the next 15 years. This should be coupled concomitantly with improvements in the conservation and management of capture fisheries through stock rebuilding, targeting of under exploited fish stocks, more rational harvesting practices and wider application of fish food technology to reduce post harvest losses.

The growth in aquaculture is currently estimated at over 200% as the private sector and the middle class cash is on high market demand for food fish domestically, regionally and internationally. It is expected that the aquaculture industry will grow from an estimated 2000 t annual production currently to an estimated 100 000 t in the next ten years (Uganda Fisheries Resources Department, 2004).

The main constraints to increased aquaculture production in Uganda include: inadequate appropriate fish seed; limited variety of culture species; lack of appropriate fish feeds; lack of capital; poor pond management practices; inadequate information and guidance on environmental concerns; lack of information to guide restocking of minor lakes;

inadequate extension services; limited adoption of appropriate fish culture systems; limited commercial aquaculture enterprises; impact of socio-cultural beliefs; inadequate information on economic viability of aquaculture.

Water Quality and Quantity Key research findings and lessons

Over the past four decades or so, Lake Victoria has come under increasing and considerable pressure from a variety of interlinked human activities such as over-fishing, species introductions, industrial pollution, eutrophication, and sedimentation (Hecky, 1993; Water Quality Synthesis Report, 2005).

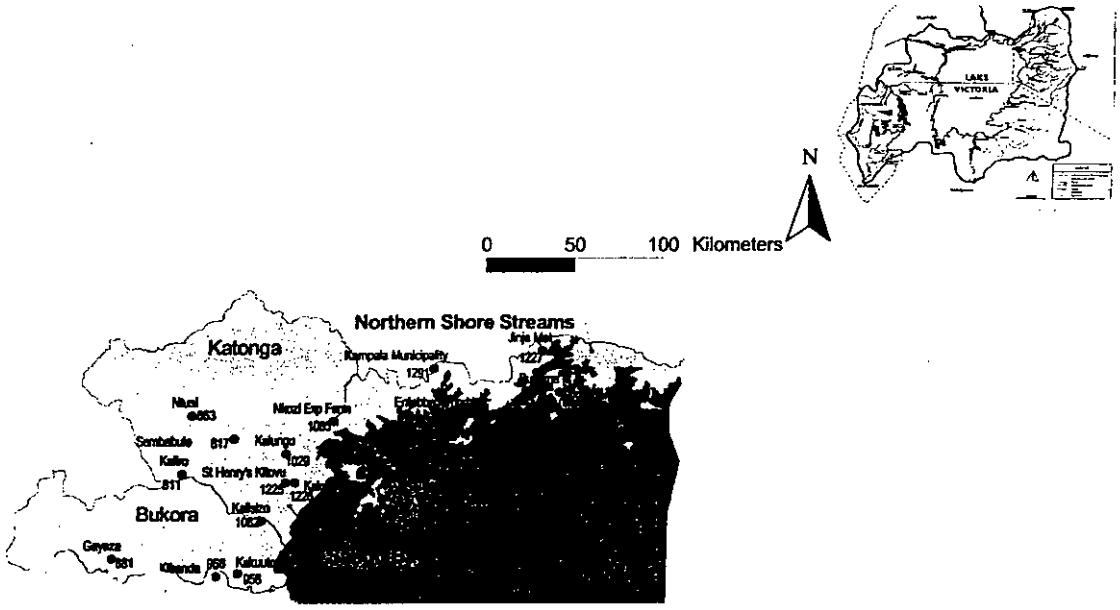


Figure 1. Map of Lake Victoria Basin (Uganda) and its sub-catchments.

The water quality and Ecosystems Management Component of LVEMP1 made considerable progress towards understanding Lake Victoria's water quality and its ecosystem as well as effects of resource utilization and exploitation on the lake and its catchment. The following, among others, were the issues addressed by the WQ component:

i. deterioration of water quality in Lake Victoria.
ii. nature, composition and characteristics of the pollutants.
iii. nutrients in the lake water and the organisms they sustain.
iv. characteristics of sediments.
v. prevalence of water-borne and water related diseases.
vi. hydrologic processes and their balance.
vii. inadequate data and information.
viii. inadequate capacity for water quality management.

Summary of Findings

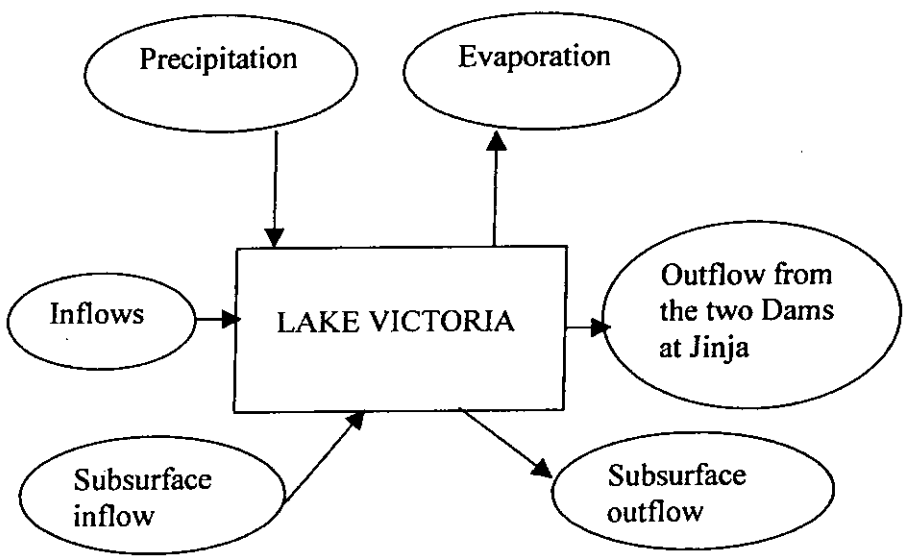
Water Quality and Quantity

Lake Monitoring

i. A number of sampling networks for littoral, pelagic and urban monitoring stations were established.
ii. Trends in physical and chemical parameters were monitored.
iii. Cruises were taken.

Hydro-Meteorological Conditions

Rainfall and evaporation over Lake Victoria are the most important hydrological processes within the lake with rain fall serving as the principal input into Lake Victoria and evaporation as the most important uncontrolled loss of water from the lake. There are also other regulated man made processes controlling inflows and outflows of large quantities of water from Lake Victoria as depicted below:



The rainfall pattern over the lake and land areas of the basin exhibits a typical bimodal characteristic. The lowest rainfall falls in the months of August and September for pre-LVEMP and LVEMP periods following the wind pattern.

Annual Mean, Maximum and Minimum Rainfall (mm) For the Pre and L VEMP Periods

			Northern Shore		
	Bukora	**Katonga**	**Streams**	**Average**	**Lake Rain**
Pre-LVEMP Average	882	948	1307	984	2011
Average L VEMP	838	1048	1426	1043	2241
% of Average	95	111	109	106	111
Monthly maximum	1375	1340	2290	1379	3114

(pre-L VEMP					
Monthly maximum (L VEMP)	1035	1265	1734	1244	2868
Monthly minimum (pre-L VEMP)	674	560	916	664	1374
Monthly minimum (L VEMP)	677	810	1111	873	1378

i. Uganda's land catchments annual rainfall contribution to Lake Victoria is approx. 312 Million m3/s.
ii. Mean annual rainfall over the Ugandan side is about 2020 mm and this forms 35.2% of the mean annual lake rainfall.
iii. No significant trends in rainfall were observed over the period of study.
iv. Evaporation was less than rainfall by a factor of 0.66.
v. Lake levels in relation to the Nile outflow shows that there has been a close relationship between the levels and amount of water released through the Owen Falls dam.
vi. General absence / limited rains on the lake in recent years contributed to falling of lake levels.
vii. Increased outflows at the Owen Falls dam for power generation contributed to a further fall in lake levels by about 0.34 m from the year 2001 – 2004.
viii. Full understanding of this scenario needs understanding net basin supply (NBS) and outflow data from the rest of the basin.

Non-Point Pollution Loading

i. Total suspended solids (TSS), organic matter (OM) and total nitrogen (TN) concentrations were river-dependent.
ii. River Bukora had significantly higher concentrations compared to River Katonga ($P<0.01$).
iii. Total phosphorus (TP) concentrations were similar in Katonga and Bukora, and increased linearly with time ($p=0.05$).
iv. The concentration of TSS fluctuated, the peak was in the year 2000 for Bukora and 2001 for Katonga ($p<0.05$).
v. The sub-catchments loaded 2.1 t/day of TN and 0.3 t/day of TP, confirming small contribution compared to atmospheric deposition, which loaded 26.4 t/day of TN and 5.6 t/day for TP from the wet deposition.
vi. Atmospheric deposition is the major source of pollution to the lake. Total atmospheric deposition (wet and dry deposition) contributes about 49.07%
vii. The major pollutants generated from the fishing villages are organic (BOD5,), nutrients (nitrogen and phosphorus) and pathogens (faecal coliforms).

Industrial and Municipal Effluents Management

i. Pollution hotspots were identified.
ii. Fishing villages contribute significantly to Lake Victoria pollution.
iii. Factories in Kampala, Jinja and Entebbe with threat to lake pollution were identified.
iv. It was established that about 14.17 tons of BOD, 2.91 tons of N and 1.93 tons of P / day is discharged into Lake Victoria from urban centres.
v. 2.96 tons of BOD, 0.37 tons of N and 0.19 tons of P / day is discharged from 124 fishing villages.

vi. Industrial loads were estimated to be 2.51 tons of BOD, 0.34 tons N and 0.11 tons P per day.
vii. Use of natural and constructed wetlands showed a significant role in pollution reduction.
viii. Pollution management strategies and sanitation improvement were proposed.
ix. Only about 40% of garbage is centrally collected garbage, a considerable quantity of garbage is washed into the lake by heavy rainfalls.

Hydraulic conditions

i. Data on temperature, water velocities, oxygen concentration and secchi depths were studied from 1999 to 2005.
ii. The temperature distribution profiles on the eastern part of the lake showed similar patterns to historical observations.
iii. Water column temperatures and stratification are very prominent in the months of February, March and April.
iv. Temperature reaches a maximum in February, just before the March equinox (date when sun is overhead equator or the tropics of Cancer and Capricorn) and gets its lowest records in July after the June equinox.
v. The western part of Lake Victoria is much influenced by winds hence more mixing and cooling patterns.
vi. The eastern part of Lake Victoria is much more influenced by thermal stratification patterns and therefore mixing is mainly due to density currents.
vii. The eastern part of Lake Victoria experiences higher water temperatures throughout the year due to a lower rate of light penetration and weaker mixing.
viii. There are two strong seasonal wind patterns that influence the hydraulic process of the lake.
ix. In the months of January-February and June-September, the wind pattern is predominantly East West, parallel to the equator, with origins from the Nandi hills in western Kenya. These are fairly dry winds. The moisture they pick are deposited to the western catchments especially Bukora catchment.
x. During the period of March-May and October-December, the wind pattern changes towards the northern parts of the lake

Sedimentation

i. Sedimentation rates were highest at littoral compared to pelagic stations.
ii. The composition of the settling material is highly organic and of algal origin.
iii. Inshore sediment cores had lower annual sediment burial rates than deep offshore.
iv. Only 10-15% of trapped carbon and nitrogen is permanently buried on an annual basis in contrast to 40% of phosphorus.
v. The trapped amounts of biogenic silicon are insufficient to account for recent historic rates of burial.
vi. This is consistent with the depletion of soluble reactive silicon in the lake as a consequence of P enrichment, causing eutrophication.
vii. Sediment cores indicate that increased loading of P began prior to 1940 and continues to the present.
viii. The increased loading of P has depleted dissolved Si in the lake's mixed layer and oxygen in the deeper waters.
ix. The created nitrogen demand can only be met through nitrogen fixation creating conditions where cyanobacteria now dominate.

x. Restoration of ecological conditions characteristic of the first half of the last century will require reductions in P loading.

Eutrophication of Lake Victoria

i. Lake Victoria has clearly shown signs of eutrophication since the late 1980s.
ii. Phosphorus concentrations have risen by a factor of 2 to 3.
iii. High nutrient concentrations support elevated algal primary production and algal biomass have risen by a factor of 2 and 6 to 8 respectively.
iv. Average algal primary production has increased 2-fold and supports a 4 – to 5 – fold increase in yield compared to 1950s.
v. Estimated abundance indicated higher densities of organisms and diversity indices around littoral compared to pelagic habitats, these trends are explained by a more productive inshore that receives nutrients.
vi. Vertical distribution of zooplankton is related to profiles of temperature and dissolved oxygen.
vii. In shallow littoral habitats, there was no development of thermocline and oxycline.
viii. In contrast, the vertical distribution at deeper pelagic stations indicated concentration of organisms in mid-to-surface water layers due to development of low dissolved oxygen conditions.
ix. The frequent encounter of these organisms is an indicator of the deteriorating water quality of the lake basin.
x. Adverse eutrophication effects include harmful algal blooms associated with fish kills; and reduction in lake transparency; changes in algal and invertebrates communities, loss of desirable fish species and seasonal bottom water oxygen depletion (anoxia).

Pesticides, agrochemicals and heavy metals

i. Use of agricultural chemicals in the catchment has increased in recent years.
ii. Studies under LVEMP and other international investigators have revealed gross abuse and misuse of agricultural chemicals in Uganda.
iii. Many restricted chemicals are being used by untrained persons while adulteration of some is common.
iv. A number of banned organochlorinated pesticides (e.g. DDT, endosulfan, dieldrin and lindane) were detected in air showing that they may still be in use.
v. However, these pesticides were not detected in sediments, water or fish tissue.
vi. Studies also showed that herbicides Touch Down (48% Glyophosate trimesium) and Gasepax (2,4-D and Ametryne) used in sugarcane cultivation pose no environmental threat in runoff water, soil and fish, four months after field application.
vii. Elevated metal concentrations (Mn, Zn and Cr) detected in some rivers were, related to industrial activities or runoff from urban areas.
viii. High Total Hg concentrations were higher in recently deposited lake sediments than older ones, indicating increased environmental degradation.
ix. Nevertheless, Hg concentrations in sediment, water and fish from Lake Victoria were below the WHO and international environmental guidelines.
x. Results call for more stringent measures to control the types of agricultural chemicals used in the catchment coupled with massive sensitization of communities on safe handling and use of agrochemicals.

Water and Health

i. Studies indicated that the shore waters were highly contaminated.
ii. Riparian communities sourced their water for domestic use mainly from the lake.
iii. Seasonal variation in coliform counts correlates positively with waterborne disease incidences that were higher in the wet season.
iv. The most prevalent diseases in the landing sites were malaria, dysentery, diarrhea and bilharzias.
v. Cases of cholera, skin-related infections and influenza, where also observed.
vi. Fishers vulnerability to water-related diseases was further aggravated by inaccessibility to both health facilities and personnel.
vii. There was a significant difference in disease cases between those who used latrines regularly and those who did not.
viii. Other potential health risks in the communities arose from frequent algal blooms.
ix. Cyanobacteria (potentially toxic to humans and animals) impaired ecological and aesthetic values of the lake.
x. Algal blooms caused unpleasant odours and tastes in domestic water supplies, clogged filters on pumps and machinery, increased chlorine demand, requiring a more complex and expensive treatment process and ultimately.raised tariffs.
xi. Use of Ecosan toilets constructed by LVEMP in the riparian communities was estimated to be less than 50% on average, because of user fee and socio-cultural factors.
xii. People disposed their wastes in nearby bushes or in polythene bags, contaminating water sources with fecal material and leading to waterborne diseases.
xiii. Findings suggest that water quality and sanitation improvements, in association with hygiene behaviour change can have significant effects on population and health by reducing a variety of waterborne and water-related diseases.

Impacts of water quality change on beneficial uses of Lake Victoria

i. Lake Victoria is of immense economic and environmental importance.
ii. Currently, it supports an estimated population of about 30 million (in the entire lake basin).
iii. Its socio-economic, scientific and environmental benefits lie mainly in respect to its land and water uses, unique land and waterborne biodiversity, wetlands and fisheries products and of its immeasurable aesthetic values.
iv. Lake basin is a source of food, energy, drinking and irrigation water, shelter, transport, and as a repository for human, agricultural, municipal and industrial.
v. Combined populations of the three countries with gross economic product is of US$ 4 – 6 billion annually.
vi. Savings in the annual cost of water hyacinth control estimated to be US$ 6 – 10 million, while savings in the cost of cleaning water supply is currently at a minimum of US$ 3.5 million per annum.
vii. Savings in the cost of health services due to improved quality of water and sanitation can result into diminished incidence of diseases among the riparian communities.

viii. Massive blooms of algae have developed, water borne diseases have increased in frequency and infestation of water hyacinth is choking important waterways and landings as well as water supply intakes.
ix. Subsequently increase in expenditure on treatment and control measures has raised poverty levels among riparian communities

Capacity Building

i. During the 7 years of LVEMP, 5 MSc. and 1 PhD scientists were trained in various fields of water quality and quantity studies.
ii. Several specialized short courses were offered to a number of scientists on the component of water quality and quantity.
iii. A number of specialized training consultancies were procured including outreach through workshops relevant to water quality management.
iv. Other specialized and knowledge upgrade areas addressed were:
   a. Hydraulic conditions training using "wet lease equipments"
   b. Procured "wet lease contract": RDI Acoustic Doppler Current Profiler (ADCP), RBR Temperature and Temperature/ Depth loggers
v. A number of specialized training consultancies were procured including outreach through workshops relevant to water quality management.
vi. CSI Data logging system and peripherals were procured.
vii. A short limnology course was held at Makerere University in the year 2001.
viii. Other on job-trainings under LVEMP support included the COWI and DHI training.
ix. The efficiency of laboratory and field infrastructure was improved.

Challenges and gaps

i. Although the training input is significant, it was geared toward academic training and less towards on-the-job training, particularly in the art of analysis and interpretation of data.
ii. The training on the water quality model which had been provided for was not implemented, and the model is not currently used (not functional) due to lack of training (at least 5 people are required to be trained in this area) although the necessary data generated by LVEMP1 is now available.

Some of the gaps in knowledge that will need to be addressed in future are highlighted here.

Lake Sedimentation and Siltation

i. Effective management of silt in artificial water sources e.g. valley dams
ii. Biogenic silicon vs. P enrichment
iii. Sediment – water interface biology
iv. Sedimentation flux rate studies (siltation rates)
v. Data collection involving use of local fishermen/communities.

Water Quantity / Levels

i. Assessment and monitoring of rainfall.
ii. Assessment and monitoring of groundwater potential.
iii. Coping with variability in quantity and reliability of rainfall.
iv. Capability to make safe groundwater with undesirable chemical content.
v. The root causes of the declining Lake Victoria levels versus increasing water use, demand and population explosion.
vi. Lake levels in relation to the Nile outflow.

vii. Water balance of whole lake.
viii. Studying the Net Basin Supply.

Point-source pollution

i. Implementation of pollution management and sanitation strategies.
ii. Proactive protection of wetlands.
iii. Fishing villages participation i.e., awareness raising programs, waste management, home-based water treatment technologies, local development funding.
iv. Industries for adoption of cleaner production.
v. Continuous mapping and monitoring of industrial, municipal and shoreline settlement pollution loading in the catchment.
vi. Strategic management of Nakivubo channel/wetland.
vii. Gazettement, bio-manipulation and rejuvenation of the already destroyed wetlands.
viii. Pilot projects for municipal and industrial effluents for the purposes of technology transfer and information dissemination to stakeholders.

Water hyacinth and other invasive weeds

Several gaps and challenges remained at the close of LVEMP 1. The obvious ones are:

i. the initial institutional mechanism left no policy and legal framework for water hyacinth control; hence the programme does not have a standing government budget.
ii. Biological control weevils have not been successfully introduced in the riverine environments, including the Kagera River.
iii. The quantity of water hyacinth biomass entering Lake Victoria from Kagera River is not known

Lessons Learned

i. There is need for collaborative and multidisciplinary effort
ii. The Potential for Community Involvement in Project as the failure of some project activities was clearly linked to non-involvement of grass root communities in the preparation and execution of activities of the project.
iii. The need for Integration of Research Findings into Management Strategies
iv. Unplanned urbanization including proliferation of rural and lakeside commercial centres and settlements can be costly in terms of environmental degradation
v. Poor solid waste management in urban centers contributes significantly to pollution of surface runoff through uncollected garbage heaps.
vi. Shoreline settlements, though individually small population-wise, are a great threat to lake water quality because of their big total number and proximity to the lake.
vii. Training and education of qualified professionals are primary prerequisites for effective lake basin management.

Investment areas in water quality and quantity

i. Procurement of sediment core analysis equipment;
ii. Upgrade of NWSC central laboratory;
iii. Wastewater treatment facilities for municipalities and large urban centres.
iv. Further building of capacity especially:
   a. in modeling;

APPENDIX III. Summary of the key Issues, Trends and Researchable Areas in Lake Victoria Basin

THEMATIC AREA 1: CAPTURE FISHERIES AND AQUACULTURE				
CAPTURE FISHERIES				
Issues	Contributing factors	Known trends	Known effects	Researchable areas/Gaps
Declining fish catches and deteriorating biodiversity	Over fishing; Capture of immature fish; Use of destructive fishing gears and methods e.g. beach seines, trawl nets; Sedimentation and pollution Degradation of fish habitat Hypoxia in the deeper zones of the lake; Ignorance about location of critical habitats e.g. breeding grounds, nursery beds fish refugia and biodiversity hot spots; Extensive draw down in lake	Capture of increasingly immature fish; Recruitment over-fishing; Reduction of suitable fish habitat; Biodiversity degradation	Poor catches and decline in biodiversity	Enhancing fish populations through re-stocking in satellite lakes Enforcement of use of legal fishing gears in collaboration with strengthened BMUs; Identification and protection of critical biodiversity hot spots, key fish breeding and nursery habitats as well as fish refugia in collaboration with local stakeholders; Identification and monitoring of the effects of draw down in lake level on breeding and nursery of major commercial fish species; Identification and monitoring of the effects of draw down in lake level on biodiversity; Enhance the treatment effluents

	level			
Limited application of research information for management purposes	- Inadequate coordination of research and management planning; - Inadequate dissemination of research results; - Emphasis on basic research by researchers; - Bias against research approach by managers	- Inadequate appreciation of the role of research in management planning	- Limited application of research results by managers	- Identification and mitigation of key underlying causes; - Popularization of joint planning between managers and researchers;
High post harvest losses along fish production chain	- Retrieval of fish catch after death and use of gears that kill fish in the lake; - Poor processing technology; - Inappropriate storage conditions; - Prolonged stay of processed fish products on the shelf	- Inadequate appreciation of the role of research in management planning	- Limited application of research results by managers	- Identification and mitigation of key underlying causes; - Popularisation of joint planning between managers and researchers;
Under utilized riverine and	Limited information on fishery potential			- Evaluation of wetland and riverine fishery resources

wetland fisheries				
THEMATIC AREA 1. CAPTURE FISHERIES AND AQUACULTURE (*continued*)				
AQUACULTURE				
Inadequate appropriate fish seeds and variety	Few fish species have been researched on for fish farming	- Low quantities of available fish seeds - There has been no variety for the consumer to have a pick, and also for the farmer to have enough to export	- Low production - There has been no urge for fish farmers to go commercial	- Promoting economically viable aquaculture in the LVB. - Enhance low-cost technologies on breeding and production of aquaculture seeds - Evaluate the different fish species in aquaculture
Lack of appropriate fish feeds	There has not been enough feeds, and no variety of feeds	- Not much semi-intensive and intensive fish farming, and therefore people have turned to the relatively low productive extensive farming	- Low aquaculture production and subsistence aquacultural practice has continued	- Research in the variety of fish feeds for the various fish types and species
Poor pond management practices	Low and insignificant production of fish	- Many ponds do not ultimately produce fish optimally because of poor pond management	- The ponds produce stunted fish, the waters are of poor quality and are stinking	- Develop pond management strategies
THEMATIC AREA 2. WATER QUALITY AND QUANTITY				
Issues	**Contributing factors**	**Known trends**	**Known effects**	**Researchable areas/Gaps**
Eutrophication	-Soil particles washed off by erosion	-Excessive nutrients from land use activities -dry and wet	Reduction in lake transparency - Changes in algal and	- Establish effective water quality monitoring system - Develop appropriate and low

	-Burning wood-fuels -Human and animal waste from catchments -Untreated municipal waste -Industrial effluents e.g. abattoirs, breweries, soap	atmospheric deposition -Increased runoff from agriculture, sewage & municipal systems -P and N risen -Elevated primary production -Excessive algal blooms -Macrophytes proliferation -Invertebrate species composition changed	invertebrate communities -Loss of desirable fish species/ Fish Biodiversity Loss -Poor Fish Breeding and Recruitment, -High Fish Mortality -Poor Fish catches. -Water oxygen depletion (anoxia) -Low Household Incomes Food Insecurity Malnutrition Civil Unrest Unemployment -Filters, pumps and machinery clogged -Increased chlorine demand -Increased treatment costs and tariffs -Lake and River Eutrophication and Siltation Reduced water quantities Power shortages – adverse impact on economic activities Increased costs of water supply	cost wastewater treatment technologies - Determination of optimum nutrient levels for aquatic production (at different trophic levels) to avert excessive loading of nutrients and pollutants into Lake Victoria - Research and adoption of cleaner production practices - Research into emerging issues such as algal toxins - Research on social issues associated with sanitation (e.g. ECOSAN toilets) - Influence of eutrophication on primary production and species diversity (phytoplankton and zooplankton) - Identification, mapping and demarcation of biodiversity hotspots including riparian wetlands. - Design programmes for community participation, awareness and interest in management of the lake water resources. - Develop and implement Market-Based Instruments (MBIs) for control of pollution.

			Threats to aquatic life	
Point source Pollution and Non point source Pollution	- Untreated municipal / industrial wastes (solid and liquid effluents) - Household wastes - Quarrying / mining of construction materials - murram, sand, clay - Oil spills from marine vessels - Agrochemicals - Poor agricultural practice (soil erosion) - Deforestation - Persistent organic pollutants - Livestock keeping - Wetlands encroachment	- Pollution hot spots - High prevalence of water related diseases - Increased atmospheric deposition - Increased faecal coliforms loading - Increased inorganic material (anions and heavy metal) and organics loading - Increased sedimentation/siltation - Increased nutrient loading (N, P, NO3-) - Increased BOD, COD - Foul smelling water - Lowering/increase of pH - Heavy metals and PCB's contents in fish (Fisheries)	- Overall – water quality deterioration - Reduced water transparency - Poor fish breeding - Water borne diseases - Eutrophication	- Research into source reduction/cleaner production procedures - Develop home-based low cost water treatment technologies - Bioaccumulation / biomagnification of pollutants (inorganic / organic) in the food chain - Energy generation (biogas) from wastes (involving youths and women) - Develop community based Land use plan for R. Kagera and R. Ruizi basins
Declining water quantity	- Climatic patterns low rainfall (drought) - Hydro-power generation	- Declining lake levels - Increased evaporation - Reduced precipitation	- Reduced water quantities - Power shortages adverse impact on economic activities	- Establish base-flow into lake to establish contribution of groundwater to lake inflow (lake water quantity) - Updating the water balance

	- Water extraction from the lake (industries) - Catchment degradation - Deforestation	- Reduced inflow from rivers - Increased outflows through the Nile - Deepening ground water table	- Water supply pumps extended further into the lake - Increased costs of water supply - Threats to aquatic life - Drilling water deeper - Resurgence of Aquatic weeds	model to be used as management tool for lake basin resources - Bathymetric mapping of Lake Victoria (e.g. as a navigation aid for large marine vessels) - Establishing causes of declining lake levels
THEMATIC AREA 3. ATMOSPHERIC DEPOSITION OF NUTRIENTS				
Issues	**Contributing factors**	**Known trends**	**Known effects**	**Researchable areas/Gaps**
Increased atmospheric nutrient loading of the lake	- Atmospheric deposition (wet deposition, dry deposition, and air-water exchange). - Indiscriminate trash and bush-burning	- Increased atmospheric contaminants e.g., Chlordane, DDT, Dieldrin, α-Endosulfan, Hexachlorobenzene, and Lindane are being deposited into the Lake. - By 2000 there were no detectable levels of pesticide such as DDT, HCH, PCBs, organophosphates, pyrethroids, and malathion or their derivatives found in water, sediments and fish from Lake	- Bioaccumulation and biomagnification of pesticides in fish tissue threatens the fish export market. - Fish kills and death of other fauna - Health-related problems associated with agrochemicals in humans e.g. methaemoglobinemia (especially in infants) - Non-certified users and applicators of agrochemicals might	- Assess the relative importance of atmospheric deposition to the lake and provide information on pollutant sources [trends in pollutant concentrations in air and rainfall and loading estimates]. - Conduct research to develop scientific models that would help predict the source and fate of the different contaminants in the atmosphere - Conduct process research to understand how contaminants are deposited into the lake and how they cycle between air and water within the lake system. - Assess the contribution of heavy-duty diesel vehicles,

		Victoria.	hurt their health, others health and environmental health.	light duty vehicles that use leaded gasoline, soil dust, furnaces, paint spray booths, and municipal incineration to a suite of pollutants. - Assess the environmental and public health effects of atmospheric pollution - Examine what rules or activities are in place [locally, regionally, and internationally] that address impairment caused by atmospheric deposition and through a participatory process determine what additional actions are necessary to address the impairment caused by atmospheric deposition

THEMATIC AREA 4. CATCHMENTS MANAGEMENT				
Issues	**Contributing factors**	**Known trends**	**Known effects**	**Researchable areas/Gaps**
Inappropriate handling and use of agrochemicals (pesticides, herbicides, acaricides and fertilizers)	- Poor management (handling & use) of agrochemicals - Use of agrochemicals that were banned long ago e.g. DDT - Use of chemicals in the restricted-	- Increased nutrient loads in surface runoff and eroded sediments - Presence of chlorinated pesticides which were banned long ago or in the restricted-use category in	- Bioaccumulation and biomagnification of pesticides in fish tissue threatens the fish export market. - Accelerated eutrophication - Fish kills and death of other fauna - Health-related problems associated	- Scaling up sensitization efforts on proper use of agrochemicals and assessing impact - Study the impact of agrochemicals on the food chain, system productivity and lake environment - Assess the environmental and public health effects of agrochemicals - Develop a database of possible

	use category, e.g. endosulfan, by non-certified users	atmospheric deposits.	with agrochemicals in humans. - Non-certified users and applicators of agrochemicals might hurt their health, others health and environmental health.	sources of contaminants and map out hot spots (e.g. flower gardens) - Conduct a comprehensive mass balance study on Lake Victoria to understand the inputs and outputs of contaminants in the water, sediments and the food chain - Identify less expensive and more accurate methods/ equipment to assess the significance of agrochemicals to the lake and to monitor for particular chemicals of concern. - Identify remedial methods for sites with high concentrations of particular contaminants e.g. sediment clean-ups.
Inadequate/ ineffective policies to regulate agrochemicals handling and use	Weak or non-existence policies Non-compliance Lack of enforcement	The agrochemicals industry is unregulated	Improper handling and use of agrochemicals leading to environmental degradation	- Examine what rules or activities are in place [locally and regionally] that address impairment caused by agrochemicals and through a participatory process determine what additional actions are necessary to address the impairment caused by agrochemicals - Identify appropriate ways to integrate research and the policy formulation process - Identify scientific tools to craft

				solid policy strategies targeted to source areas and source sectors - Develop a scientific base of information to guide toxic load reductions - Develop basin-wide policies and practices on use of certain persistent chemicals with residual pollution effects - Identify and promote environmentally friendly practices in agrochemicals application to contribute to development of multisectoral standards e.g. use of DDT - Explore mechanisms to strengthen existing monitoring institutions e.g. Agrochemicals Control Board - Evaluate the impact of policy decisions
Lack of scientific data on the efficacy of local organic materials	- Poor documentation of indigenous knowledge (IK) - Inadequate communication between farmers, extension agents, and researchers	- Local organic materials (pesticides & fertilizers) are highly effective and could be used as import substitutions for inorganic pesticides and fertilizers	- Inability to standardize - Poor promotion and adoption	- Establish the efficacy and cost-effectiveness of homemade agrochemicals

Heavy metal contamination	- Mining in the catchment - Biomass burning - Gasoline leaded fuel - Factories (e.g. tannery, fish, paint) - Wastes from hospitals and laboratories - Increased soil erosion from the catchment, recent flooding events and continued high water levels post-1961 could increase mobility of the Hg previously sequestered in soil and lake sediments.	- Total Hg concentrations in the lake are higher in recently deposited sediments than earlier in the last century.	- Bioaccumulation and Biomagnification in the food chain; - Threat to ban on the Lake's Fishery.	- Study the cycling of the heavy metals in the lake basin - Study the bio-accumulation and bio-magnification of heavy metals in the wetland ecosystem. - Assess the contribution of heavy-duty diesel vehicles, light duty vehicles that use leaded gasoline, soil dust, furnaces, paint spray booths, and municipal incineration to a suite of pollutants
Extensive degradation of land and wetland resources in the catchment	- Conversion to agricultural use - Deforestation - Overstocking of livestock - Bush burning - High population pressure - Land	- Depletion of fauna and flora - Habitat loss - Drying –shrinking of wetlands - Increasing land degradation in the lake basin (due to increase in level of	- Loss of fertility - Loss of buffering and filtration capacity - Loss of aesthetic value - Loss of income - Increasing levels of pollution,	- Enhancing the buffering capacity of wetlands - Participatory development and promotion of strategies for restoration of natural wetlands - Research and adopt organic farming - Industries should research and adopt cleaner production

	fragmentation/land shortage - Unplanned/ competitive land use e.g. grazing vs. protected areas - Excessive harvesting of fauna and flora - Wetland encroachment - Lack/un-affordability of alternative energy sources - Urbanisation and industrial growth - Extensive use of non-biodegradable organically based packaging materials - Brick making, sand and clay mining partly due to limited off-farm activities and lack of alternative construction materials	causative factors) - Increased soil erosion and runoff, mass movements in hilly areas leading to siltation of water bodies - Agricultural practices in the lake basin remain poor and increasingly unsustainable - Increasing population pressure leading to agriculture intensification (e.g. continuous cultivation) and area expansion - Loss of natural vegetation to agricultural land - Increasing pressure on catchment forests and trees for paper, charcoal and wood fuel, with limited alternative energy sources - Forest cover loss at a rate of 86,500 per year between 1990 and 2000	- Overloading lake with silt - Reduced land, crop and animal productivity - Terrestrial and aquatic biodiversity loss - Too much runoff leads to flooding - Sedimentation and siltation of water bodies and clogging of waterways/dams - Pollution of water bodies - Eutrophication of lake water - Loss of habitats and biodiversity - Increased algal blooms leading to high fish mortality - Poor fisheries - Poor household incomes - Malnutrition - Food insecurity - Unemployment - Water related diseases - Loss of terrestrial and aquatic biodiversity and	technologies - Onsite treatment of industrial wastewaters - Identify and upscale economically viable soil erosion control, water conservation and fertility enhancement technologies (build on LVEMP 1 and other pilot studies in the region). - Develop, promote and upscale use of appropriate land use plans for the lake basin. - Pilot studies on water harvesting strategies and design of generic valley dams for livestock watering on rangelands. - Determine the magnitude, effects and monetary value of land degradation in the lake basin. - Identify and promote economically viable off-farm activities. - Promote alternative, cost effective fuel sources for domestic and industrial use (e.g. wind, solar, geothermal). - Identify, promote and up scale economically viable afforestation and re afforestation activities. - Building capacity and systems

		- Decreasing biodiversity - Charcoal consumption increasing at a rate of 6% per annum -	productivity - Loss of important forest functions as carbon sinks, pollution reduction, climate regulation, soil conservation and ecological balance - Loss of agricultural land and wetlands due to brick making, sand and clay mining - Large holes left uncovered after excavation serve as breeding grounds for mosquitoes and contribute to health-related problems	for local governments to engage actively in government and private forestry. - Develop eco-friendly alternative uses of forests. - Research to increase off-take of livestock and livestock products involving pastoralists. - Identify and popularize alternative building materials - Cost-benefit analysis of afforestation - Conduct studies to demonstrate the social, economic and environmental benefits associated with afforestation
The buffering capacity of wetlands have declined	Filtration (and regulation) of nutrients, materials, chemicals flowing into the open waters is not up-to-par.	Some wetlands have lost the capacity to filter adequately because of activities like over-cultivation	- Nutrients, toxic chemicals and materials are let through to open waters, silting and polluting the lake. - Frequent flooding is on the increase.	- Bio-manipulation of the wetlands to enhance buffering capacity
Local and Regional climatic change contributing to the	- Low and erratic rainfall regimes - Changes in hydrological	Absence of wetland and forest vegetation reduces evaporation /evapo-transpiration	- Frequent severe droughts - Drought/water shortages,	- Develop models for forecasting local and regional changes in climate - Develop and promote

global changes	cycle and lake circulation, and lake level changes	leading to changes in rainfall patterns	hydrological water-table declines	afforestation activities in the catchment - Identify and promote mitigation measures for climate change
Unsustainable land use practices	- Irrational agriculture - Deforestation - Bush burning - Land fragmentation/land shortage - Unplanned land use - Excessive harvesting of fauna and flora - Wetland degradation - Extensive deforestation and bush burning - Poor unsustainable farming practices - High population pressure - Land fragmentation - Continuous cultivation and loss of vegetation which expose land to	Increased runoff and soil erosion, mass movements in hilly areas leading to siltation of water bodies	- Loss of nutrients/fertility - Terrestrial and aquatic biodiversity loss - Too much runoff leads to flooding - Sedimentation and siltation of water bodies and clogging of waterways/dams - Eutrophication from agrochemicals - Fish Biodiversity Loss - High fish mortality (fish kills) - Poor fisheries - Poor household incomes - Malnutrition - Food insecurity - Unemployment	- Technology development for water and soil conservation (build on pilot studies of LVEMP 1) - Carry out land use survey for the riparian states - Pilot studies on new conservation techniques that may be scaled up if successful - Pilot studies on design generic valley dams - Socio-economic studies to identify and document reasons for failure to adopt better land management technologies. - Identify and promote low cost (and cost effective) soil erosion control and fertility enhancement. - Methods for water harvesting in rangelands. - Private sector participation in promotion of new agricultural technologies - Identify long-term monitoring and data collection strategies for future management of river streams, the lake and its catchment. - Develop a model for estimating

	harsh conditions - Low adoption of soil management practices - Overgrazing - Extensive use of non-biodegradable organically based packaging materials - Brick making, sand and clay mining partly due to limited off-farm activities and lack of alternative construction materials			soil loss under the different land use practices - Eco-friendly farming practices in order to reduce pressure on land and wetlands resources
Decline in catchment forests cover	- Logging of trees - Clearing for settlement - Clearing for cultivation - Lack of replanting after logging - Lack/un-affordability of alternative energy sources - Deforestation by refugees	- Increasing loss of forest land due to conversion to cultivation - Increasing pressure on catchment forests and trees for paper, charcoal and wood fuel, with limited alternative energy sources - Excessive wood harvesting compared to	- Loss of land cover, biodiversity of flora and fauna - Accelerated deforestation leading to soil erosion, siltation of rivers, wetlands and lakes - Deterioration in water quality	- Conduct studies to demonstrate the social, economic and environmental benefits associated with afforestation - Alternative fuel sources for domestic and industrial use. - Cost-benefit analysis of afforestation - Building capacity and systems for local government to engage actively in government and private forestry. - Develop eco-friendly alternative

		replanting activities - Increased soil erosion - Reduced biodiversity		uses of forests - Adopt alternative energy sources (e.g. wind, solar, geothermal)
Rangelands degradation	- Population growth leads to increased demand and opening up of more land for crops and animals - Competitive land use – grazing vs. protected areas - Low and erratic rainfall regimes - Uncontrolled burning	- Cutting down acacia? for charcoal burning - Shrinking grazing land - Uncontrolled livestock movement - Deforestation	- Frequent severe droughts - Migration of pastoralists in search for water within the "cattle corridor" within Uganda and neighbouring countries - Social unrest - Depletion of high quality grass - Problems of disease control through unmarked routes - Problems of providing social services - Lower household incomes	- Research to increase off-take of livestock and livestock products involving pastoralists. - Develop capacity to restore soil fertility through nitrogen fixation and improve grazing lands and overall ecosystem productivity.
THEMATIC AREA 5. AQUATIC WEEDS				
Issues	**Contributing factors**	**Known trends**	**Known effects**	**Researchable areas/Gaps**
Inability to control water hyacinth in riverine	Failure of *Neochetina* sp. weevils as biological	Unabated proliferation of water hyacinth	Inflow of large quantities of water hyacinth biomass into Lake	Develop regional strategies for control of water hyacinth to include Rwanda and Burundi

environments especially River Kagera	control agents		Victoria	
Inflow of large quantities of water hyacinth biomass into Lake Victoria from River Kagera	Weed proliferation in River Kagera	Continuous inflow of weed biomass into Lake Victoria	- Smothering of benthic fauna of Lake Victoria with water hyacinth debris; - Nutrient loading of Lake Victoria	- Develop effective and sustainable management options for water hyacinth in River Kagera and other riverine environments associated with Lake Victoria
Resurgence of water hyacinth	Not established – possibly availability of key nutrients	Stronger annual resurgence since 1999. strongest in 2006	- Mechanical damage by mobile weed biomass to fishing gear, water transport engines and recreation facilities; - Degradation of the water environment under weed mats through exclusion of light and free aeration; - Depletion of dissolved oxygen and release of toxic gases and fine debris due to continuous death and decomposition of weed biomass; - Displacement of biota including fish	- Explore factors (e.g. environmental, social, economic) driving sustained resurgence of water hyacinth. - Promote timely interventions and effective management options for resurgence of water hyacinth.

			requiring high oxygen levels in zones of extensive weed cover; - Physical obstruction including interference with fishing activities, transportation on waterways, recreational activities and access to domestic water sources; - Interference with commercial water abstraction and hydropower generation through clogging of pumps at water intake and treatment plants and cooling systems for hydro electric generators, respectively, by fine debris from rotten water hyacinth.	
Proliferation of some native water plants to weed status	Not known	Increasing since initial control of water hyacinth in 1998	- Obstruction to free movement of canoes - Obstructs the setting and retrieval of	- Obstruction to free movement of canoes - Obstructs the setting and retrieval of fishing gears especially gillnets

			fishing gears especially gillnets	
Absence of early warning system for management of water hyacinth and other invasive water weeds	Lack of sustained monitoring of status and trends of water hyacinth distribution and infestation status	- Project based motoring with involvement of limited stakeholders - Monitoring practically ceased at the end of LVEMP 1	- Limited understanding of temporal dynamics of water hyacinth infestation and proliferation - Inadequate information for developing effective weed management plans	- Develop national and regional early warning systems for management of water hyacinth and other invasive water weeds
THEMATIC AREA 6. SOCIO-ECONOMIC AND PRIVATE SECTOR DEVELOPMENT				
Result Areas 1: Generating options for boosting environmental health and community development				
Projects 1: Programme for Community based Environmental sanitation and disease control:				
Issues	**Contributing factors**	**Known trends**	**Known effects**	**Researchable areas/Gaps**
Poor environmental sanitation and communicable diseases Low adoption of inappropriate technologies Limited coverage and inefficient technologies for wastes treatment Lack of linkage	- Transient nature of fisheries and pastoral communities - Remoteness of fishing villages making it difficult for service providers - Low coverage and poor sanitation facilities	- The prevalent diseases, levels of infection and areas of concentration - Some of the Causes and initiatives - Seasonality and hot spots - The transient nature and the difficulties of medical personnel to reach them.	- Reduced labor in fisheries - High child mortality - Poor health	- Develop and pilot a long-term tracking system for monitoring communicable diseases among transient populations. - Inadequate information of underlying causes of the high prevalence of the communicable diseases (e.g. why ECOSAN and other technologies were not adopted) - Pilot study on behavioral change interventions to mitigate communicable

between private sector and research Poor saving and investment by producer communities	especially, - Low latrine coverage, portable water coverage, - Proximity to and frequency of direct contact with contaminated water, - Poor garbage collection and disposal - Increasing population densities.			diseases - Identify and scale up successful interventions in water quality and quantity (Nsumba village in Rakai - Support community participation and organization in planning, construction, maintenance and management of water supply and sanitation (low potable water coverage
Result Area 1: Projects 2: Enhancing synergies between sustainable Natural resource management and community development				
Persistent poverty amongst producer communities Low, irregular and poor quality yields (livestock, fish and crops) Deforestation in forestry reserves and inadequate	- Lack of alternative income sources to shelter households against unpredictable shocks: - Low literacy levels, skills, and exposure	- Livelihood strategies - Social economic challenges that hamper progress - Initiatives - Areas and causes of some conflicts - Initiatives	- People in fishing villages live from hand to mouth. - Private sector faces challenges to extend services - Over exploitation of the natural resource base	- Devise mechanisms (e.g. networking and strengthening NGOs and CBOs) for effective mobilization of communities in the development and management of fisheries and natural resources (e.g. use of IK – medicinal plants, IPM, etc) Pilot study on sustainable livelihood approaches in scaling up good practices (e.g. LVEMP I land use; diversify

resources for proper management Low marked incentives for increasing quality and enhancing yields. Low community participation in natural resource management and economic development Un-coordinated management of socio-natural resources issues	necessary for building confidence to explore and experiment with alternatives: - Weak community institutions: - Vulnerability to easy exploitation - Land tenure and freedom to invest in infrastructure development:		- Insecurity and thefts - Rampant livestock diseases transmitted across communities - Poor public and social services	income sources) - Explore mechanisms for more equitable benefit sharing from the fisheries sector - Evaluate Participatory rangeland management options - Incentives to private developers on community investment and long-term development - Explore potential areas for co-management in public and livestock health. - Investigate options for Co-management of trans-boundary issues. - Underlying causes of insecurity, theft of fishing gears, piracy - Detailed survey to identify key trans-boundary management issues of major public health and livestock diseases
Result Areas 2: Enhancing Private sector involvement and support to socio economic development efforts of the catchment				
Result Area 2: Project 1: Public-private sector partnership for generation and diffusion of appropriate (and affordable) technology				
Widespread use of inappropriate technologies Lack of linkage between private sector and research	Transient nature of communities Capacity and literacy levels Cost of technologies	Poor information dissemination and uptake by the general public. Poor public performance as a result of bureaucracy	Most investors shun partnership with public sector. Poor waste disposal and infrastructure. Persistent poverty	- Up scaling appropriate technologies e.g. energy saving technologies, alternative to natural resources such as building materials, packaging materials) - Research into use and adoption of appropriate fishing

Poor saving and investment by producer communities Conflicts/ power struggle between government decisions making institutions	Limited capacity public sector to engage private sector Stringent policies and laws governing commercial engagement in natural resources Lack of alternative income generating activities	Private sector interest has remains low. Vulnerable livelihood strategies		and farming gears - Development of strategies for linking private sector with research - Joint studies of economic viability of prospective enterprises (e.g. of aquaculture, cage culture, water harvesting & storage, post-harvest handling and value addition) - Review existing micro-finance services and other organizations and propose appropriate models for producer communities - Review existing policies, laws and practices to assess their conduciveness to private sector investment.
Result Area 2: Project 2: Generating options for enhancing private-public-community partnerships for sustainable natural resources based development: Private				
Low, irregular and poor quality yields Changes in fishing policies and land use Deforestation in forestry reserves and inadequate resources for	Low incentives to invest in technologies and boosting yields. Producing for unknown markets. The majority of the livelihood strategies are wood dependant	High dependence on natural resources by communities. Low interest of private sector in traditional producer communities Concentration of credit facilities in urban centers	Depletion of natural resource Increased illegal activities, Little or no economic progress in producer communities Fragmented markets	- Research into use & adoption of appropriate yield boost strategies (e.g. fish feeds, crop and livestock production technologies, soil fertility enhancement options, quality control and management) - Review past interventions in demand-driven research-extension and recommend

proper management Low market incentives for increasing quality and enhancing yields. Declining wildlife population and spp diversity outside protected areas	for fuel and building materials The available credit facilities demand 30% interest that is not conducive for small producers. Changes in land use Increased illegal hunting	Little returns on producers' products and exploitation by middlemen Declining wildlife population and disappearance of some spp (lions, hyenas)	Poor social and physical infrastructure.	good practices for linking farmers to markets and access to farm inputs (e.g. contract farming for sugar companies) - Building capacity of producers for market driven production - Monitor the implementation of the revised fishing and land use policies and their impact on private sector investment (e.g. introduction of BMUs, privatization of beaches) - Develop and promote afforestation and co-management of local forestry reserves through community participation (conflicts resolution, licensing, benefit sharing). - Scaling up NR-Private sector initiatives (Lake Mburo game cropping programme and equitable sharing of benefits; feasibility studies on game ranching)
Result Area 2: Project 3: Exploring options for developing and publicize the tourism potential of the basin (multi-stakeholder project)				
Under-developed/ underutilized tourism potential	No detailed analysis has been carried out on the potential of	Most tourists coming to Uganda know only National parks.	There has been little interest in developing the sites	- Detailed analysis of the economic potential of the various tourism sites in the

	Geo, Eco, and cultural tourism in the catchment. Poor infrastructure to some of the sites Low private sector interest in publicizing the catchment as a tourist destination	Many of the sites are inaccessible	Few tourists visit the catchment areas	catchment. - Development and promotion of private sector driven tourism (e.g. eco-tourism, geo-tourism, cultural tourism) with active community involvement through pilot studies/projects.

THEMATIC AREA 7. BIODIVERSITY

Issues	Contributing factors	Known trends	Known effects	Researchable areas/Gaps
Loss of fish biodiversity	Introduction of exotic species, over-fishing, habitat loss and pollution	Continued decline in number of fish species within the Lake Victoria Basin	Loss of fish biodiversity	- Research to halt biodiversity loss in the lake and its catchment
Change in species composition and abundance of invertebrates in Lake Victoria	Pollution, eutrophication, habitat loss	A few species have become predominant, others have become very rare	Change in species composition of invertebrates in the lake.	- Complete mapping of the distribution of fish species in Lake Victoria. - Inventory the status of fish species in satellite lakes of the basin.
Changes in species composition of macrophytes in the lake	Increased nutrients loading, Pollution Smoothening effect of water hyacinth	Decline in abundance and distribution of macrophyte species	Loss of diversity	- Research to establish underlying causes of changes in invertebrate diversity - Study the relationship between the distribution of macrophytes

				and water hyacinth
Loss of large mammalian herbivores and carnivores species in the catchment	Habitat loss Poisoning and Hunting	Continued decline in biodiversity of wildlife	Loss of biodiversity in the lake's catchment	- Review current community based conservation action plans currently run by UWA with a view of improving it - Establish an action plan for recovery of threatened species of wildlife
Loss of wetland biodiversity	Changes in land use Increasing human population Pollution	Continued decline in wetlands biodiversity	Loss of biodiversity	- Research into ways of enhancing implementing management plans for critical wetlands (e.g. Nabugabo). - Prepare an action plan to protect endangered wildlife species e.g. shoebill bird through promoting community based tourism and conservation
Loss of rangeland plants	Overgrazing Burning Climate change Absentee landlords	Continued decline in rangelands biodiversity	Loss of rangeland biodiversity	- Develop and implement a recovery plan by promoting community-based good practices - Research into ways of halting land degradation and restoration - Review existing policy on stocking rates in order to halt rangeland biodiversity

THEMATIC AREA 8. MANAGEMENT OF TRANS-BOUNDARY ISSUES				
Issues	**Contributing factors**	**Known trends**	**Known effects**	**Researchable areas/Gaps**
Lack of proper conflict management strategies	- Increasing human population - Scarcity of resources - Inadequate policy and laws - Inadequate cross-border regulations	Increasing conflicts over resources	- Increasing over-exploitation - Scarcity of resources - Insecurity - Areas and causes of some conflicts - Initiatives	- Investigate underlying causes of insecurity, theft of fishing gears, piracy - Factors contributing to conflict in resource use (cattle rustling, cross border fishing conflicts, Water use, Wetland degradation, Forest destruction, Wildlife migration, Bush fires); and potential mitigation measures (hippos, hyenas, lions, hippos, from Rwanda and Tanzania into Uganda) (3.2. VIII) such as co-management of trans-boundary resources
Increased atmospheric deposition	Poor land use practices	Increasingly becoming a big problem	- Poor water quality - Impairment of the food chain	- Toxicity of algae to fish and human beings - Effects of mercury, oils spills, agrochemicals and other chemicals on food web structure, system productivity and lake environment
Poor waste management	- Increasing human and livestock populations - Poor regulations	- Increasing poorly managed waste - Increasing water-born diseases	- Poor water quality - Ill health - Increased poverty	- Develop new technologies for basin wide water treatment - Harmonize water treatment regulations and standards - Social aspects of water

	- Inadequate capacity			treatment e.g. failure to use ECOSAN toilets - Constructed wetlands
Crop pests and livestock diseases	- Unregulated livestock movements - Lack of effective control measures	High prevalence of livestock diseases and crop pests	- Poor crop yields - Poor quality livestock products - Increased poverty	- Conduct detailed survey to identify key trans-boundary management of major public health, livestock diseases and crop pests and develop strategies for their control
Sedimentation	Poor land use practices	Increasing sedimentation rates	- Poor water quality and quantity - Loss of habitat for fish breeding	- Pilot afforestation - Role of Wetlands in mitigating sedimentation - Promote good land-use practices
Wetland degradation	Changes in land-use -Increasing human population -Unsustainable land use practices	Increasing wetland degradation	- Loss of biodiversity - Poor water quality - Poor water storage capacity - Poor water buffering capacity	- Restoration of selected wetland - Develop options for promoting participatory wise-use of wetlands - Research into policies and regulations to enhance wise use of wetlands
Invasive weeds	Poor land use practices Pollution Social factors	Resurgence -Emergency of new aquatic weeds	Reduced water quality and quantity -Increased costs of power generation -Blocking navigation routes and landing sites -Reduced fish catches	Factors leading to resurgence and emergence -Failure of weevils to establish in riverine environment

			-Increased disease incidences -Habitat loss	
Unsustainably managed fish stocks	-over fishing -use of illegal gears -Poor cross-border regulatory mechanisms -Pollution	- Declining fish stocks	- Reduced catches - Declining fish biodiversity - Increased poverty	- Develop options to mitigate use of illegal fishing gears and methods - Collect data to feed in modelling fish stocks - Harmonise fisheries policies, laws and regulations - Develop options for resolving trans-boundary fishing conflicts - Mechanisms for protecting breeding, nursery and refugia
Uncoordinated Trans-boundary trade and commerce	Lack of documentation and regulations -Few gazetted entry and exit points -Informal nature of cross-border trade	- Increasing - Increased smuggling	- Cross-border trade is increasing	- Review existing policies and regulations with a view to enhancing them - Develop and pilot a database for recording origin, quantities and destinations of natural resources products
THEMATIC AREA 9. DATA AND DATABASE MANAGEMENT				
Improving Data Collection, Processing, Storage and Management				
Issues	**Contributing factors**	**Known trends**	**Known effects**	**Researchable areas/Gaps**
Lack of standards and formats for collecting and managing data	Insufficient learning time to improve on standards and quality of the data	Inconsistency in the sampling framework and data storage	little data collection and analysis activities Incompatibility of data	- Standardization of techniques of data collection to improve the quality and usability of data through creating metadata

(spatial and non spatial parameters)	collected during LVEMP phase 1. No attempt was made to standardize data collection and storage			- Standardization and periodicity of key parameters for measurements.
Inadequate capacity for database development , management and use	Incompatibility of databases No easy access to data through any form of access.	Databases managed on individual institutional basis	Little data sharing.	- Develop a seamless GIS database management, accessible to stakeholders. - Set up user rights for database access - Development of capacity for use and management of databases
Lack of enabling environment and capacity for sharing among different thematic areas of research, projects of LVEMP 1 and other sources	Instructional bureaucracy	Limitations in data access among different organizations.	Little collaboration and data sharing	- Integration of data collection, storage and management for all projects. - Promotion of trend analysis through ensuring long term preservation and accessibly to the database as an incentive. - Developing institutional policies to create enabling environment for networking

APPENDIX IV: TEAM COMPOSITION AND TASK ALLOCATION

Technical/Managerial Staff		
Name	**Position**	**Tasks**
Dr. Fredrick J. Muyodi	Lead Consultant	a. Overall coordination and management of the consultancy team and activities b. Identification of key activities for applied research / monitoring in connection with water quality and quantity issues c. Identification of key activities for applied research / monitoring in connection with wetlands ecology and functioning d. Identification of gaps to be addressed in the proposed prioritized Applied Research Programme for LVEMP2
Dr. Fred W. B. Bugenyi	Physical-chemical limnologists / Wetlands Ecology	a. Review literature and consultations concerning all aspects of aquaculture and wetlands ecosystems and ecology in the Lake Victoria Basin (in the riparian states) in development of aquaculture, research and management; and the same for wetlands ecology. b. Identify gaps from what has been done in terms of research, development and management of aquaculture and wetlands. c. Collect baseline data on aquaculture and wetlands in the basin by visiting relevant institutions, individuals and stakeholders. d. Participate in workshops involving the above-mentioned stakeholders and together identify gaps and training needs in the above-mentioned applied research areas; and propose methods to solve these gaps and problems. e. Together with the team of consultants, review information on regional Trans-boundary Natural Resources Management and incorporate the component of wetlands and the practice of cage culture in aquaculture in the basin.
Dr. Gilbert Isabirye-Basuta	Ecologist	a. Catchment forest ecology (together with Sam Mugisha and Dr. Semalulu) will look at how deforestation is affecting the ecosystem of Lake Victoria. Different levels of forest degradation and their causes, and how they could be stopped. b. Identify areas for re-afforestation by the private sector and local communities. c. Capacity building (assess training needs in various institutions in both infrastructure and human resources) d. Wildlife ecology (identify the taxa of wildlife currently under threat, and trans-boundary issues of wildlife. e. Human-Wildlife conflicts (crop raiding), wildlife user

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		rights, the private sector in management anc conservation of wildlife, control of problem animals ranging patterns, issues of wildlife corridors
Dr. Andrew Muwanga	Environmental Geologist/Hydro-geologist	a. Review of literature and consultations concerning mining/industry and its impacts in the Lake Victori Basin in the riparian states; water quality, sedimentation and pollutant loading into the basin. b. Collect baseline data on hydrogeology in the LVB. c. Conduct workshops involving various relevan stakeholders to identify gaps and training needs in Applied Research in areas mentioned above d. Together with the team, review information or Regional Trans-boundary Natural Resources Management and incorporate component of mining in the lake basin e. Participate in proposing of implementation framework for the Applied Research Programme f. Be involved in preparing a final and prioritized research programme and framework
Dr. Timothy Twongo		a. Identification of key activities for applied research on fisheries and aquatic weeds. b. Identification and preliminary review of key literature on fisheries resources research and management; and on control of aquatic weeds. c. Consultations with relevant key stakeholders on fisheries resources management and control of aquatic weeds. d. Identification of key issues in the management of fisheries resources; and control of aquatic weeds in Lake Victoria Basin. e. Preparation of inception report. f. Detailed literature review and consultation with key stakeholders. g. Formulation of and prioritization of activities for a research program towards sustainable management of fisheries resources addressing environmental and socio-economic concerns including for grassroots' communities. h. Formulation and prioritization of activities for a research program towards sustainable control of aquatic water weeds. i. Development of prioritized research programs for fisheries resources management; and for control of aquatic weeds. j. Participate in the Stakeholder workshop to review and contribute to drafting the Prioritized Applied Research Program.
Dr. John Obbo Okaronon	Fisheries Biologist and Ecologist; Fisheries Stock	a. Identification of key activities for Applied Research Programme on Capture fisheries resources of Lake Victoria and its Basin. b. Detailed literature review and consultation with key

	Assessment Scientist.	stakeholders on the utilization, research and management of capture fisheries resources in the Lake Victoria Basin. c. Identification of key issues in the utilization, research and management of Capture fisheries resources in the Lake Victoria Basin. d. Preparation of Inception Report on Applied Research Programme in the Lake Victoria Basin. e. Formulation of and prioritization of activities for a research programme towards sustainable utilization and management of capture fisheries resources for environmental and socio-economic benefits in the Lake Victoria Basin. f. Development of a Prioritized Applied Research Programme for capture fisheries resources utilization and management in the Lake Victoria Basin. g. Participation at the Stakeholder workshop to review and contribute to draft Applied Research Programme in the Lake Victoria Basin; h. Participation in the preparation of the final and Prioritized Applied Research Programme and framework for the Lake Victoria Basin resources.
Mr. Sam Mugisha		a. GIS, database management b. To look into the essential ingredients of a functional database which include, but not limited to, the following: c. The development of standards and formats for collecting and managing data (spatial and non spatial parameters) for each specific applied research theme (land use, fisheries, loss of natural vegetation, atmospheric pollution, human/animal/crop diseases, investment opportunities). d. The capacity for database management and use (focusing on both spatial and non spatial databases and their integration, institutional arrangements) e. Enabling environment (political, policy and technical) for sharing data among different thematic areas of research, projects of LVEMP (at national and regional levels) f. Capacity to share key information, pertaining to individual applied research areas, with key stakeholders (researchers, scientists, policy makers, private sector, government and international agencies)
Ms. Monica N. Kapiriri		a. Social economic issues b. Review literature and consultations on issues of demand-driven research extension systems encompassing the private sector c. Building capacity of local communities to mobilize

		savings and building of micro-finance institutions d. Initiation of participatory approaches to invol communities e. Impacts of HIV/AIDS f. Gender issues g. Cross-cutting issues
Dr. Onesmus Semalulu		a. Lead the preparation of a detailed research propose on atmospheric deposition with emphasis c phosphorus. b. Conduct a thorough stakeholder review to identif and document reasons for the poor adoption c proven better land management technologies in th Lake Victoria basin, including any success stories. c. Propose innovative participatory researc approaches to develop and popularize low cost best bet technology options, upscale success stories and strategies for soil erosion control and soil fertilit management aimed at increasing land uni productivity while conserving the environment. d. Propose sustainable strategy for long-term monitoring of water in river streams so as to establish benefits and long-term trends accruing from any catchment conservation efforts. e. Propose areas of private sector participation in popularization of successful technologies (e.g. through fabrication and popularization of promising field equipment, multiplication of improved planting material, etc...). f. Study the feasibility of micro catchment approach to promoting soil and water conservation including absentee landlords, who may own land and yet not resident in an area, and yet their land parcels may be potential sources of soil erosion and runoff. g.
Mr. Cornelius. Kazoora		a. Budgeting and costing the Applied Research Programme.
Mr. Emmanuel. Kasimbazi	Environmental Lawyer	a. Legal issues b. Review literature and consultation on legal related matters c. Identify key activities for Applied Research on legal related policy matters

Support Staff

Dr. Eric Sande and Robinson Odong

Coordinate all activities of the consultancy.
Compilation of reports.
Editing and proof reading reports
Collecting relevant documents from resource centres.

APPENDIX V A. LIST OF INSTITUTIONS AND PEOPLE CONSULTED

Name	Position/Institution
Mr. Tom Waako Baguma	Program Officer, NBI
Mr. Kahangire	Nile Basin initiative (NBI)
Mr. Bart Hilhorst	Chief Technical Advisor, FAO/NBI
Mr. Waiswa Ayazika Arnold	Environment Impact Assessment Coordinator, NEMA
Dr David Hafashimana	Sen. Forest Inspector, Forestry Inspection Division
Mr. Gershom Onyango	Forestry Inspection Division
Mr. Aggrey Rwetsiba	UWA Research and Monitoring Coordinator
Mr. Nuwe John Bosco	UWA Community Conservation Coordinator
Mr. Mark Ocen	Min of Tourism, Wildlife and Antiquities
Mr. David	Min of Tourism, Wildlife and Antiquities
Mr. Xavier Mugumya	National Forest Authority (NFA)
Dr. John Balirwa	Director, National Fisheries Research Institute (NAFIRI)
Ms. Margeret Aanyu	NAFIRI
Ms. Gertrude Namulemo	NAFIRI
Mr. Moses Magumba	NAFIRI
Mr. Taabu Anthony	NAFIRI
Dr. O.K. Odongkara	NAFIRI
Dr. Lucas Ndawula	NAFIRI
Dr. S.B.K. Sekiranda	NAFIRI
Dr. Dismas Mbabazi	NAFIRI
Dr. Fred Wanda	NAFIRI
Dr. Levi Muhoozi	NAFIRI
Mr. Sylvester B. Wandera	NAFIRI
Ms. Winnie Nkalubo	NAFIRI
Mr. Patrick Bwire	NAFIRI
MS. Alice Endra	NAFIRI
Mr. Isaac Mukobe	NAFIRI
Ms. Margaret Massette	KARI
Mr. Thomas W. Maembe	Executive Secretary Lake Victoria Fisheries Organization (LVFO)
Dr. Richard Oguttu-Ohwayo	LVFO
Ms. Caroline Kirema Mukasa	LVFO
Dr. Oliva Mkumbo	LVFO
Mr. James Scullion	Manager FMP, LVFO
Mr. Samson Abura	GIS/Data Base Management LVFO
Mr. Nsubuga Ssenfuma	Commissioner WRMD, DWD (MWE)
Mr. Joel R. Okonga	Focal Point Person for Uganda, LVEMP
Mr. Jackson Kitamirike	WRMD, DWD
Mr. Abdalla Matovu	MRMD, DWD
Mr. Dick Nyeko	Commissioner, Fisheries, MAAIF
Dr. Magunda	Director, KARI
Dr. G. Mbahinzirike	NAFIRRI, Kajjansi
Mr. O. Owori-Wadunde	NAFIRRI, Kajjansi
Mr. C. Kanyesigye	Coordinator (PCC), Municipal and Industrial Wastes Mgt Component LVEMP
Ms. Sarah Tibatemwa	Chief Quality Analyst NWSC
Mr. Paul Mafabi	Assistant Commissioner, Wetlands Inspection Division, MWE

Mr. Frank Muramuzi	Chairperson, East African Communities' Organization for Management of Lake Victoria Resources (ECOVIC) Uganda Chapter
Mr. Frank Muramuzi	Executive Director, National Association of Professional Environmentalists (NAPE)
Mr. Seremos Kamuturaki	Executive Director, Uganda Fisheries and Fish Conservation Association (UFFCA)
Mr. Musingwire Jeconious	District Natural Resource Official, Mbarara
Mr. Cyrl Mugyenyi	Head, Natural Resources Management Department, Bushenyi
Mr. Ssekandi David	Rakai
Mr. Kiyingi	District Water Officer, Rakai
Ms. Nakaliiri Olivia	District Physical Planner, Rakai
Ms. Najjuma Florence	Ag. Natural Resources Coordinator, Rakai
Mr. Biribonwa Stephen	District Fisheries Officer, Rakai
Mr. T. Mukasa	District Forestry Officer, Rakai
Dr. Kiwanuka Kimbugwe	Ag. District Production Coordinator/ District Veterinary Officer, Rakai
Mr. Mawanda Annas	Secretary for Production & Natural Resources/Vice chairman LC V, Masaka district
Mrs. Mutumba	District Agricultural Officer, Masaka
Mr. Mutyabula Naluswa	Asst. Forest Services Officer, Masaka district
Ms. Biwoye V. Muwanga	Dep. District Fisheries Officer, Jinja
Mr. Ernset Nabihamba	District Environmental Officer, Jinja
Mr. Budegega H	BMU, Masese, Jinja
Mr. Obia P	Tenderer, Masese, Jinja
Mr. Ibanda H	M/A, Masese, Jinja
Mr. Nabongo B	BMU, Masese, Jinja
Mr. Ssajabi P	BMU, Masese, Jinja
Mr. Nsereko J.B.	BMU, Masese, Jinja
Mr. Nandala M.L.	C.A.O. Mayuge
Dr. Ouma	District Veterinary Officer, Mayuge
Mr. Bikweke J	Dep. District Fisheries Officer, Mayuge
Mr. Kyakwise S	District Education Officer, Mayuge
Makopo M. F.	Mayor/BMU, Buluba, Mayuge
Mwidu D	Fisheries/BMU, Buluba, Mayuge
Onyango R	Fisheries/BMU, Buluba, Mayuge
Waiswa P	Fisheries/BMU, Buluba, Mayuge
Oketch D	Fisheries/BMU, Buluba, Mayuge
Musa M	Fisheries/BMU, Buluba, Mayuge
Owala N	Fisheries/BMU, Buluba, Mayuge
Kigaya P	Fisheries/BMU, Buluba, Mayuge
Mr. Magala	Vice Chairman, Buluba, Mayuge
Mr. Mukasa F	Fisheries/BMU, Katosi, Mukono
Katende, L	Fisheries/BMU, Katosi, Mukono
Muweeki A	Fisheries/BMU, Katosi, Mukono
Namaganda M	Fisheries/BMU, Katosi, Mukono
Kalyesubula S	Fisheries/BMU, Katosi, Mukono
Mbulakyalo B	Fisheries/BMU, Katosi, Mukono

Kabenge M	Fisheries/BMU, Katosi, Mukono
Eguyu D	Fisheries/BMU, Katosi, Mukono
Bukenya G	Fisheries/BMU, Katosi, Mukono
Mr. P. Were	District LCV Chairperson, Busia
Mr. Isaac Atukunda	District Water Officer, Busia
Mr. Emong James	Pep. District Fisheries Officer, Busia
Mr. Benson Juma	BMU Chairman, Majanji, Busia
Mr. Oundo C	Vice Chairman BMU, Majani, Busia
Mr. Emanuel Areikin	District Forest Officer, Busia
Mr. Malowa Charles	District Administration, Busia
Barasa A	BMU, Madua Majani, Busia
Odwori C	BMU, Madua Majani, Busia
Bwire M	BMU, Madua Majani, Busia
Muyomba F	BMU, Madua Majani, Busia
Ngolobe S	BMU, Madua Majani, Busia
Wandera R	BMU, Madua Majani, Busia
Bwire H	BMU, Madua Majani, Busia
Chaburu A	BMU, Madua Majani, Busia

APPENDIX V B. NATIONAL WORKSHOP TO DISCUSS REPORTS OF CONSULTANCIES ON LVEMP II PREPRATION – UGANDA

Tuesday 19th – 21st December, 2006: Sunset Hotel, Jinja
LIST OF PARTICIPANTS

NO.	NAME	DESIGNATION	ORGANISATION	ADDRESS
1.	Mr. Charles Owach	Assist FAO Representative	FAO	P.O. Box 521, Kampala Tel 041- 250771 Mobile: 077 2 487079 Fax: 041 250579 Email: Charles.Owach@fao.org
2.	Dr. Isabirye Basuta	Head of Department/Project Component coordinator	Zoology Department. Makerere University	Box No. 7062, Kampala Tel: 041 – 531902 Mobile: 071 2 813552 Fax: Email: head@zoology.mak.ac.ug
3.	Dr. Vincent A. Ssembatya	Dean, Faculty of Science	Makerere University	Box No. 7062, Kampala Tel: 041 532401 Mobile: 077 2 374144 Fax: 041 531061 Email: vas@math.mak.ac.ug
4.	Ms. Monica Kapiriri	Consultant/Development Facilitator	C/O Zoology Department, MUK	P.O. Box 28144, Kampala, Uganda Tel: Mobile: 077 2 590398 Fax: Email: mkapiriri@yahoo.co.uk
5.	Mr. Sanya Patrick	Commissioner, Transport Regulation	Min. of Works Housing and Communications	P. O. Box No. 10, Entebbe Tel: 041 320418 Mobile: 071 2 950710 Fax: 041 321364/ 320135 Email: mowhc@utlonline.co.ug psanya@works.go.ug
6.	Dr. Twongo Timothy	Consultant	Department of Zoology, MUK Environment and	P. O. Box No. 2033, Jinja Mobile:077 2 490470 Fax:

7.	Mr. Joel Richard Okonga	National Focal Point Officer - LVDP	Development Associates Water Resources Department, Ministry of Water, Lands and Environment	Email:ttwongo@yahoo.com Box No. 19, Entebbe Tel: 041 323531 Fax: 041 321368 Mobile: 071 2 469687 Email:okonga.wrmd@dwd.co.ug
8	Dr. John Obbo Okaronon	Consultant	Zoology Department Makerere University	P.O. Box 7062, Kampala Tel: Mobile: 077 2 603212 Fax: Email: okaronon2000@yahoo.com
9.	Dr. Raymond J. Mngodo	National Project Coordinator	LVEMP II	P.O. Box 35066, Dar es Salaam, Tanzania Tel: 0-22-2450838 Mobile: 0754-298330 Fax 022 - 2450269 Email:raymngodo@yahoo.com
10.	Mr. Stanley Matowo	National Focal Point Officer/Senior Economist	Ministry of Water	P.O. Box 9153, Dar-es-Salaam Tel: 255 22 2450244 Mobile: 255 784 318269 Fax 255 22 2452179 Email: stanmatowo@yahoo.com
11.	Mr. Lumaama Kiwanuka Joseph	Secretary General	Lake Victoria Region Local Authorities Coop (LVRLAC)	P. O Box No. 7010, Kampala Tel: Mobile: 077 2 447142 Fax: Email:lvrlacsec.net.com
12.	Prof. Kenneth Mavuti	Consultnat	Coda-Uganda	P. O. Box 30197, Nairobi, Kenya Tel: 254-204446141 Mobile: 254 733610971 Fax: 254 - 204446141 Email: Kmavuti@unobi.ac.ke
13.	Dr. Wilson Waiswa Mwanja	Principal Fisheries Officer	Department of Fisheries Resources	P. O. Box 4, Entebbe, Uganda Tel. N. 041 322231 Mobile: 0772594923 Fax: 041 322334 Email: wwmwanja@yahoo.com
14.	Ms. Anna Nantale	General Secretary	ECOVIC – Ugandan	Box No. 519, Iganga

			Chapter	Tel: 043 242445 Mobile:077 2 500699 Fax: 043 242345 Email: nantaleanne@yahoo.com
15	Mr. Robert Kilama	Accountant/Disbursement Officer	Lake Victoria Environmental Management Project	Box No. 5, Entebbe Tel: 041 320040 Mobile:077 2 461957 Fax: 041- 321385 Email: rkilama@lavemp.or.ug
16.	Prof. F. W. B. Bugenyi	Associate Professor	Department of Zoology, Makerere University	P. O. Box 7062, Kampala Mobile: 075 2 659595 Email: fbugenyi@zoology.mak.ac.ug fwbugengyi@yahoo.com
17.	Mrs. Caroline T. Kirema-Mukasa	Senior Economist	Lake Victoria Fisheries Organisation	P. O. Box 1625, Jinja – Uganda Tel: 043-120205/6 Mobile: 0752 615262 Fax 043 – 123123 Emai: mukasa@lvfo.org
18.	Mr. Parata Roy Luke	Principal Economist	Ministry of Lands, Housing and Urban Development	P. O. Box 7096, Kampala Tel. No. 342931 Mobile: 0712 223626 Email:
19.	Mr. Benjamin N. Kamugasha	Consultant	Uganda Manufacturers Association Consultancy Information Services (UMACIS)	P. O. Box 3599, Kampala Mobile 0772 88 32 33 Email taxap@africaonline.co.ug
20.	Mr. Musinguzi Gerald Brooks	Systems Administrator	MUIENR Makerere University	P. O. Box 7072, Kampala Tel: 530135 Mobile: 0782 579975 Email: brooks@muienr.mak.uc.ug Jakbroo2001@yahoo.com
21.	Dr. Agaba E. Friday	Principal Medical Officer	Ministry of Health,	P. O. Box 7272, Kampala Mobile: 077691236 Email: agabafriday@hotmail.com agaba.Friday@health.go.ug
22.	Mr. Ngobi Siragi	ICT Concultant	SYSCORP International	Plot 40 – Bukoto Street, Kampala

				Tel: 533512 Mobile: 0712 618093 Email: singo3kv@hotmail.com
23.	Dr. Fred M. Wanda	Project Component Coordinator Senior Research Officer	National Fisheries Resources Research Institute (NAFIRRI)	P. O. Box 343, Jinja – Uganda Tel: 043 – 120484 Mobile: 0772 682065 Fax: 0433 120192 Email: fwandaful2002@yahoo.com director@firi.go.ug
24.	Mr. Robinson Odong	Consultant	Applied Research Consultancy Department of Zoology Makerere Univeristy	P. O. Box 7062, Kampala Tel: 531902 Mobile: 0772920965 Email rodong@zoology.mak.ac.ug
25.	Mr. Moses Gava	For Commissioner Principal Planning Department Ag. PQAO	Ministry of Water and Environment	P. O. Box 2006, Kampala Mobile: 0772720374 Fax: 505941 Email: gava@dwd.co.ug
26	Mr. Kyambadde Richard	Research Associate	Wetlands Inspection Division, MWLE	Box No. 9629, Kampala Tel: Fax: Mobile:077 2 595273 Email: Kyambadder@ugandawetlands.org Or richard_kyambadde@yahoo.com
27	Mr. John L. Mugerwa	First Secretary	Ministry of EAC Affairs	P.O. Box 341, Kampala, Uganda Tel: 041 348184 Mobile: 071 2 663171 Fax: 041 232874 Email:jlmugerwa@yahoo.com
28	David K. Twahirwa	Consultant	Development Consultants International	Box No. 23229, Kampala Tel: 041-346120 Mobile:077 2 498381 Fax: Email:david_twahirwa@yahoo.com
29	Mr. Paul Mafabi	Assistant Commissioner/PCC Wetlands Mgmt	Wetlands Inspection Division, MWE	P.O. Box 9629, Kampala, Uganda Tel: 041 254706 Mobile: 077 2 503255 Fax: 041 348772

30	Mr. Christopher Kanyesigye	Project Component Coordinator	Industrial and Municipal Waste Mgmt, NWSC	Email: mafabip@ugandawetlands.org Box No. 7053, Kampala Tel: 041 – 341144 Mobile: 077 2 425675 Fax: 041 255441 Email:chriskanye@yahoo.com
31	Dr. Mathias Magunda	Director/PCC Landuse Mgmt	NARO - Kawanda Agricultural Research Institute	Box No. 7065, Kampala Tel: 041 – 567649 Mobile:077 2 885692 Fax: 041 567649 Email: karidir@imul.com or landuse@infocom.co.ug
32.	Dr. Onesimus Semalulu	Research Officer	NARO Kawanda Agriculture Research Institute	P. O. Box 7065, Kampala Tel: 041-567696 Mobile 077-2-615009 Fax: 041 567649 Email landuse@infocom.co.ug
33.	Mr. Oluka-Akileng I	Principal Forest Officer	For Catchment Afforestation Forest Inspection Division Ministry of Water and Environment	P. O. Box 1752, Kampala Mobile 077 – 2- 495070 Email: oluka_Akileng@yahoo.com
34	Mrs. Chiria D. Eunice	Administrative Secretary	Lake Victoria Environmental Management Project	Box No. 5, Entebbe Tel: 041 321459 Fax: 041 321385 Mobile: Email: echiria@lavemp.or.ug
35	Mrs. Annette Balihikya	Secretary	Lake Victoria Environmental Management Project	Box No. 5, Entebbe Tel: 041-321459/320040 Mobile: 071 2 920 937 Fax: 041 321385 Email: abalihikya@lavemp.or.ug
36.	Ms. Namirembe Agnes	Receptionist	Lake Victoria Environmental Management Project	Box No. 5, Entebbe Tel: 041-321459/320040 Fax: 041 321385 Email: anamirembe82@yahoo.co.uk
37	Dr. Rose Mugidde	Coordinator	EAC - LVDP	Box No. 1098, Arusha, Tanzania Tel: 007 27 2504253/8

				Fax: 007 27 2504255 Mobile: 007 745 999394 Email: mugidde@eachq.org
38	Dr. Frederick J. Muyodi	Consultant/Lecturer	Zoology Department, Makerere University	P.O. Box 7062, Kampala, Ugnda Tel: 041 531902 Mobile: 077 2 474231 Fax: 041 531061 Email: fmuyodi@zoology.mak.ac.ug
39	Mr. Lino Musana	National Project Coordinator	Lake Victoria Environmental Management Project	Box No. 5 Entebbe Tel: 041 321459/320040 Mobile: 0752788823 Fax: 041 321385 Email: lmusana@lavemp.or.ug
40	Mr. Ochiba Patrick Noah	Accounts Assistant	Lake Victoria Environmental Management Project	Box No. 5, Entebbe Tel: 041 – 320040/321459 Mobile: 077 2 428169 Fax: 041 - 321385 Email: pochiba@lavemp.or.ug
41	Mr. Otim Moses	Consultant	DCI	P.O. Box 70360, Kampala, Uganda Tel: Mobile: 077 2 984645 Email: otim@alumni.itc.nl
42.	Mr. Samuel Mugisha	Lecturer/Consultant	MUIENR	P.O. Box 7298, Kampala, Uganda Tel: Mobile: 077 2 403250 Fax: Email: smugisha@muienr.mak.ac.ug
43.	Dr. Hezron Mogoka	Programme Coordinator - LVEMP	MENRs Kenya	P.O. Box Tel: Mobile: 254 722 325500 Fax Email: hmogoka@nbnet.co.ke
44.	Mr. Rukunya Edward	Senior Fisheries Officer	Water Hyacinth Control Fisheries Department	P.O. Box 4, Entebbe, Uganda Tel: 041 320563 Mobile: 077 2 413279 Fax: 041 343930 Email: edwardrukunya@yahoo.com
45.	Prof. Gaddi	National Technical Reviewer	Makerere University	Box No. 7062, Kampala

	Ngirane-Katashaya			Tel: 041 534227 Mobile: 077 2 427656 Fax: 041 534227 Mobile: 077 2 409279 Email: gngiranek@tech.mak.ac.ug
46.	Mr. William Odinga Balikuddembe	Chairman	Environmental Journalist Association of Uganda	Box No. 33615, Kampala Tel:041 - 231998 Mobile:077 2 881727 Fax: 041 231982 Email:wbodinga@yahoo.com
47.	Ms. Abonyo Christine Kasedde	Principal Assistant	Consultancy Land Suitability Mapping MUIENR Geographic Services Makerere University	P. O. Box 7062, Kampala Mobile: 0712 – 833813 Email: acsnekasedde@yahoo.com
48.	Mr. Okulo C. J.	Asst. Commissioner	Ministry of Tourism, Trade and Industry	P. O. Box 7103, Kampala Tel. 041 314254 Mobile 077 -2 -583031 Fax: 041 341247 Email: cj@mtti.go.ug
49.	Mr. Wadanya L. D. Jackson	Principal Fisheries Officer	Department of Fisheries	P. O. Box 4, Entebbe, Uganda Tel: 256-41-320496 Mobile: 0772 482076 Email: lovewadanya@yahoo.com
50.	Mr. Olaunah Emmanuel	Principal Assist. Sec. for Under Secretary	Ministry of Water and Environment	P. O. Box 20026, Kampala Mobile: 0772 660088 Email: olaunahe@yahoo.co.uk
51.	Mr. Charles Ntale	Business Consultant	UMACIS Consulting	Plot 29 Luthuli Avenue Bugolobi P. O. Box 1108 Kampala Tel: 256 41 220371 Mobile: 077246153 Fax: 256 41 220372 Email: umacis@utlonline.co.ug

52.	Mr. Samuel G. Gichere	LVEMP Focal Point Officer – Kenya Chief Economist	MENR	P. O. Box 30126-00 200 Nairobi Tel: 020 2720808 Mobile 0722880913 Fax: 020 2725707 Email gichere@mazingiraasili.go.ke
53.	Mr. Cripus Mundua	Consultant	Environmental Health Consult Group	P. O. Box 23453,Kampala Mobile 0772 510906 or 072977430 Email: elasu2003@yahoo.com
54.	Mr. Sam Elasu	Consultant	Environmental Health Consult Group	P. O. Box 23453,Kampala Mobile 0772 510906 or 072977430 Email: elasu2003@yahoo.com
55.	Dr. William Kalema	Director/Consultant	UMACIS Consulting	P.O. Box 9113, Kampala Tel: 041 220371 Mobile: 071 2 791870 Fax: 041 320373 Email: wskalema@utlonline.co.ug
56.	Mr. Timothy Wasswa	Business Analyst/Consultant	UMA Consultancy	P.O. Box 9113, Kampala, Uganda Tel: 256 41 220371 Mobile: 071 2 879802 Fax: 256 41 220373 Email: wasswat@hotmail.com or umascis@utlonline.co.ug
57.	Eng. Henry Bidasala-Igaga	Principal Energy Officer National Technical Reviewer , LVEMP	Ministry of Energy and Mineral Development	P. O. Box.7270, Kampala Tel: 0312262345 Mobile: 0772658692 Fax: 041 349342 Email: igaga@energy.go.ug
58.	Prof. James Katorobo	Consultant	CODA Luwafu, Makindye	P. O. Box 11386, Kampala Mobile 0774 197157 Email: jkatorobo@hotmail.com
59.	Sam Ligunho	Consultant	CODA	P. O. Box

				Tel. 250503/9 Nairobi Mobile 07582575 Email: imritdzool@yahoo.com
60.	Hon. Jennifer Namuyangu	Minister of State for Water	Ministry of Water and Environment	P.O. Box 20026 Kampala, Uganda Tel. 256-41-222572 Mobile: 077 2 413770 Fax: 256 41 341543

APPENDIX V C. FINAL NATIONAL WORKSHOP TO DISCUSS REPORTS OF CONSULTANCIES ON LVEMP II PREPRATION – UGANDA

Wednesday 23rd – 25th January, 2007: Colline Hotel, Mukono
LIST OF PARTICIPANTS

NO.	NAME	DESIGNATION	ORGANISATION	ADDRESS
1.	Eng. Sottie Bomukama	Permanent Secretary	Ministry of Water and Environment	P. O. Box 20026, Kampala Tel. No. 041 505945 Mobile 0772701013 Fax: 041 – 505941 E-mail : bomukama@dwd.co.ug
2	Mr. Micheal Kiza	Senior Energy Officer	Ministry of Energy & Mineral Development	P.O. Box 7270 Kampala Tel 041- 257863 Mobile: 071 2 871546 Fax: 041 349342 Email: kiza@energy.go.ug
3.	Dr. Isabirye Basuta	Head of Department/ Project Component coordinator	Zoology Department, Makerere University	P. O Box. 7062,Kampala Tel: 041 – 531902 Mobile: 071 28313552 Fax: Email: head@zoology.mak.ac.ug

4.	Dr. William Olaho-Mukani	Director Animal Resources	Ministry of Agriculture, Animal Industry and Fisheries	P. O. Box No. 513, Entebbe Tel: 041 320825 Mobile: 077 2 653139 Fax: 041 320428 Email: dar.maaif@infocom.co.ug / wolhomukani@yahoo.com
5.	Mr. Sanya Patrick	Commissioner, Transport Regulation	Min. of Works Housing and Communications	P. O. Box No. 10, Entebbe Tel: 041 320418 Mobile: 071 2 950710 Fax: 041 321364/ 320135 Email: mowhc@utlonline.co.ug / psanya@works.go.ug
6.	Dr. Twongo Timothy	Consultant	Department of Zoology, MUK Environment and Development Associates	P. O. Box No. 2033, Jinja Mobile:077 2 490470 Email:ttwongo@yahoo.com
7.	Mr. Joel Richard Okonga	National Focal Point Officer - LVDP	Water Resources Department, Ministry of Water, Lands and Environment	Box No. 19, Entebbe Tel: 041 321342 Fax: 041 321368 Mobile: 071 2 469687 / 0753469687 Email: okonga.wrmd@dwd.co.ug
8	Dr. John Obbo Okaronon	Consultant	Zoology Department Makerere University	P.O. Box 7062, Kampala Tel: Mobile: 077 2 603212 Fax: Email: okaronon2000@yahoo.com
9	Mr. Samuel Mugisha	Lecturer/Consultant	MUIENR	P.O. Box 7298, Kampala, Uganda Tel: Mobile: 077 2 403250 Fax: Email: smugisha@muienr.mak.ac.ug

10.	Dr. Mathias Magunda	Director/PCC Landuse Mgmt	NARO – Kawanda Agricultural Research Institute	Box No. 7065, Kampala Tel: 041 – 567649 Mobile:077 2 518314 Fax: 041 567649 Email: karidir@imul.com / landuse@infocom.co.ug
11.	Mr. Eliphaz Bazira	Commissioner for Environment	Ministry of Water and Environment	P. O Box. 20026 Kampala Tel: 220203 Mobile: 077 2 504173 Fax: 505941 Email:bazirae@yahoo.com
12.	Mr. David K. Twahirwa	Consultant	Development Consultants International	Box No. 23229, Kampala Tel: 041-346120 Mobile:077 2 498381 Fax: Email: david_twahirwa@yahoo.com
13.	Mr. Robinson Odong	Consultant	Applied Research Consultancy Department of Zoology Makerere University	P. O. Box 7062, Kampala Tel: 531902 Mobile: 0772920965 Email rodong@zoology.mak.ac.ug
14.	Dr. James Okot-Okumu	Senior Lecturer	Makerere University	P. O. Box 7062, Kampala Tel: 041 530135 Mobile:077 2 411468 Fax: 041 530134 Email: jokotokumu@muiener.mak.ac.ug
15	Dr. Fred M. Wanda	Project Component Coordinator Senior Research Officer	National Fisheries Resources Research Institute (NAFIRRI)	P. O. Box 343, Jinja – Uganda Tel: 043 – 120484 Mobile: 0772 682065 Fax: 0433 120192 Email: fwandaful2002@yahoo.com or director@firi.go.ug

16	Mr. Otim Moses	Consultant	DCI	P.O. Box 35209, Kampala, Uganda Mobile: 077 2 984645 Email: otim@alumni.itc.nl
17	Mr. Kamukama Asaph	Consultant	DCI	Plot 25 Luthuri Rise Bugolobi P. O. Box 70360, Kampala Mobile 0712 831796 Email: Kamusaph@yahoo.com
18	Dr. Rhoda Tumwebaze	Rep. Permanent Secretary, Ministry of Agriculture, Animal industry and Fisheries	Ministry of Agriculture, Animal Industry and Fisheries	P. O. Box 4, Entebbe Tel. No. 041 323546 Mobile 0772 927889 Fax: 041 323653 Email: t60rhoda@yahoo.com
19	Dr. Fredirick J. Muyodi	Consultant/Lecturer	Zoology Department, Makerere University	P.O. Box 7062, Kampala, Ugnda Tel: 041 531902 Mobile: 077 2 474231 Fax: 041 531061 Email: fmuyodi@zoology.mak.ac.ug
20.	Mr. John Leonard Mugerwa	First Secretary	Ministry of EAC Affairs	P.O. Box 341, Kampala, Uganda Tel: 041 4348184 Mobile: 071 2 663171 Fax: 041 4348171 Email:jlmugerwa@yahoo.com
21	Mr. Oluka-Akileng Ignatius	Principal Forestry Officer	Catchment Afforestation Forest Inspection Division , Ministry of Water and Environment	P. O. Box 1752, Kampala Mobile 077 – 2- 495070 Email: oluka_Akileng@yahoo.com
22	Mr. Lino Musana	National Project Coordinator	Lake Victoria Environmental Management Project	Box No. 5 Entebbe Tel: 041 321459/320040 Mobile: 0752788823

				Fax: 041 321385 Email: lmusana@lavemp.or.ug
23	Mr. Ngobi Siragi	ICT Consultant	Real Tech. Systems	Mobile: 0712 618093 Email: singo3kv@hotmail.com
24	Mr. Kamuturaki Seremos	Executive Director	UFFCA	P. O. Box 25494, Kampala Mobile : 0772 474228 Fax: 041 344636 Email: Seremos802@hotmail.com
25.	Mr. Peter Wamboga-Mugirya	Vice/Chair	Environmental Journalists Association of Uganda (EJAU)	Mobile No. 0712319245 Email: puramboga@yahoo.co.uk
26.	Mr. Patrick Seruyange	Operations Officer	Delegation of the European Commission to Uganda	P. O. Box 5244, Kampala Tel: 041 701000 Mobile 077 2461078 Fax: 041 233308 Email: ptrick.seruyange@ec.europa.eu
27	Mr. Rukunya Edward	Senior Fisheries Officer/ Task Leader Water Hyacinth Control Component	Water Hyacinth Control Fisheries Department	P.O. Box 4, Entebbe, Uganda Tel: 041 320563 Mobile: 077 2 413279 Fax: 041 343930 Email: edwardrukunya@yahoo.com
28	Dr. Agaba E. Friday	Principal Medical Officer	Ministry of Health,	P. O. Box 7272, Kampala Mobile: 077691236 Email: agabafriday@hotmail.com agaba.Friday@health.go.ug
29	Mr. Mathias Mayombwe M.	Communication & Information Manager	Uganda National Farmers Federation (UNFFE)	P. O. Box 6213, Kampala Tel. 041 340249 Mobile: 0752964448 Email: unfa@starcom.co.ug /

				mymathia@yahoo.co.uk
30	Eng. Richard Cong	Ag. Commissioner, Rural Water	Directorate of Water Department, Ministry of Water and Environment	P. O. Box 20026, Kampala Tel. 039 2 749628 Mobile: 0772 500697 Fax: 041 505941 Email: cong-spqa@dwd.co.ug
31	Ms. Nantale Anne	Secretary General	ECOVIC, Iganga	P. O. Box 519, Iganga, Uganda Tel. No. 252445 Mobile: 077 2 500699 Email: nataleanne@yahoo.com
32	Eng. Mugisha-Shillingi	Ag. Director - DWD	Directorate of Water Development	P. O. Box 20026, Kampala Tel. No. 221383 Mobile: 0772406913 Fax: 504375 Email: shillingi@dwd.co.ug
33	Mr. Kyambadde Richard	Research Associate	Wetlands Inspection Division, MWLE	Box No. 9629, Kampala Mobile:077 2 595273 Email: Kyambadder@ugandawetlands.org / richard_kyambadde@yahoo.co.uk
34	Dr. Andrew Muwanga	Consultant ARP	Makerere University Dept. of Geology,	P. O. Box 7062, Kampala Mobile 071 2 803362 Fax: 041 541258 Email: amuwanga@sci.mak.ac.ug
35	Mr. Samuel Amule	Commissioner Local Government Insp.	Ministry of Local Government	P. O. Box 7037, Kampala Tel. 041 258101 Mobile: 071 2 456290 Email Samadoketa@yahoo.com

36	Prof. F. W. B. Bugenyi	Associate Professor	Department of Zoology. Makerere University	P O. Box 7062, Kampala Mobile: 075 2 659595 Email: fbugenyi@zoology.mak.ac.ug / fwbugengyi@yahoo.com
37	Mrs. Chiria D. Eunice	Administrative Secretary	Lake Victoria Environmental Management Project	Box No. 5, Entebbe Tel: 041 321459 Fax: 041 321385 Mobile: Email: echiria@lavemp.or.ug
38	Mrs. Annette Balihikya	Secretary	Lake Victoria Environmental Management Project	P. O. Box No. 5, Entebbe Tel: 041-321459/320040 Mobile: 071 2 920 937 Fax: 041 321385 Email: abalihikya@lavemp.or.ug
39	Ms. Namirembe Agnes	Receptionist	Lake Victoria Environmental Management Project	P. O. Box No. 5, Entebbe Tel: 041-321459/320040 Fax: 041 321385 Email: anamirembe82@yahoo.co.uk
40	Mr. Ochiba Patrick Noah	Accounts Assistant	Lake Victoria Environmental Management Project	P. O. Box No. 5, Entebbe Tel: 041 – 320040/321459 Mobile: 077 2 428169 Fax: 041 - 321385 Email: pochiba@lavemp.or.ug
41	Ms. Gertude Ngabirano	Regional Programme Manager	Embassy of Sweden/LVI	24, Lumumba Avenue P. O. Box 22669, Kampala Tel. 041 – 340970 Mobile: 0772 740971 Fax: 041 340949 Email: gertude.ngabirano@foreign.ministry.Se

42	Mrs. Caroline T. Kirema-Mukasa	Senior Economist	LVFO	P. O. Box 1625, Jinja, Uganda Tel. 043 120205/6 . Mobile 0752615262 043 123123 Email : mukasa@lvfo.org
43	Ms. Florence Grace Adongo	Ag. Commissioner, WRMD/PC-WQ	Directorate of Water Development, Water Resources Management Department	P. O. Box 19, Entebbe, Uganda Tel: No. 041 322440 Mobile: 078 2 66 22 05 Fax: 041 321368 Email: adongo.wrmd@dwd.co.ug
44	Dr. Drake N. Mubiru	Senior Research Officer	NARO/NARI	P O. Box 7065, Kampala Tel. No. 041 567696 Fax: 567226 Mobile: 0782 415843 Email dnmubiru@kari.go.ug
45	Dr. Kasimbazi Emmanuel	Senior Lecturer	Faculty of Law, Makerere University	P. O. Box 7062, Kampala Mobile: 0772447121 Email ekasimazi@yahoo.com
46	Mr. Charles Owach	Asst. FAO Representative	FAO	P. O. Box 521, Kampala Tel. No. 250771/250578 Mobile 0772 – 487079 Fax: 041 250579 Email: Charles.Owach@fao.org
47	Mr. Keizire Boaz Blackie	National Technical Reviewer	Ministry of Agriculture, Animal Industry and Fisheries	P. O. Box 4, Entebbe Tel. 320722 Mobile 0772402234 Fax: 320984 . Email: Keizire.Boaz@apdmaaif.or.ug
48	Mr. Christopher Kanyesigye	Project Component Coordinator	Industrial and Municipal Waste Mgmt, NWSC	Box No. 7053, Kampala Tel: 041 – 341144

				Mobile: 077 2 425675 Fax: 041 255441 Email: chriskanye@yahoo.com
49	Mr. Matovu Abudallah K.	Senior Water Analyst	Directorate of Water Development, Water Resources Management Department	P. O. Box 19, Entebbe Tel. +256 41 34342 Mobile +256 772 730038 Fax: +256 41 321368 Email: matovu.wrmd@dwd co.ug
50	Mr. Timothy Wasswa	Business Analyst/Consultant	UMA Consultancy	P.O. Box 9113, Kampala. Uganda Tel: 256 41 220371 Mobile: 071 2 879802 Fax: 256 41 220373 Email: wasswat@hotmail.com / umascis@utlonline.co.ug
51	Mr. Benjamin N. Kamugasha	Consultant	Uganda Manufacturers iation Consultancy ation Services CIS)	P. O. Box 3599, Kampala Mobile 0772 88 32 33 Email taxap@africaonline.co.ug
52	Mr. Charles Ntale	Business Consultant	UMACIS Consulting	Plot 29 Luthuli Avenue Bugolobi P. O. Box 1108 Kampala Tel: 256 41 220371 Mobile: 077246153 Fax: 256 41 220372 Email: umacis@utlonline.co.ug
53	Prof. Gaddi Ngirane-Katashaya	National Technical Reviewer	Makerere University	P. O. Box No. 7062, Kampala Tel: 041 534227 Mobile: 077 2 427656 Fax: 041 534227 Mobile: 077 2 409279 Email: gngiranek@tech.mak.ac.ug
54	Prof. James Katorobo	Consultant	CODA Luwafu, Makindye	P. O. Box 11386, Kampala Mobile 0774 197157

				Email: jkatorobo@hotmail.com
55	Ms Laura Nyirikindi	Legal Expert	PA CODA	P. O. Box 28056, Kampala Tel: 0772 777 268 lnirinkindi@proinitiatives.org
56	Prof. Firimooni R Banugiry	Consultant	DCI	P. O. Box 6344, Kampala Mobile 0772889049 Secomi2001@yahoo.com

APPENDIX VI. PAIR-WISE RANKING USED FOR PRIORITIZATION OF THE PROPOSED ARP

Criteria development

Criteria

1. Address key society concerns
2. Contribute to improving environmental quality
3. Addresses economic development
4. Addresses widespread concerns
5. Scalable, appropriate and good practices
6. Addresses trans-boundary issues
7. Little is known about the issue

Criteria	1	2	3	4	5	6	7
7	1	2	3	4	5	6	
6	1	2	6	6			
5	1	2	5	5			
4	1	2	4				
3	1	2					
2	1						
1							
	6	5	1	2	3	4	0
	7	6	2	3	4	5	1
%	25	21	7	11	14	18	4

Total: 28

Qualifying the criteria

1. **Address key society concerns**
   a. Poverty – 7
   b. Gender - 5
   c. Food security – 2.5
   d. Household income - 10
   e. Health – 7.5

2. **Contribute to improving environmental quality – 6**
   a. pollution control – 8.4
   b. sanitation improvement – 2.2
   c. wetlands conservation - 6.2
   d. Biodiversity conservation – 4.2

3. **Addresses economic development – 5**
   a. Private sector involvement - 6
   b. Benefits communities - 9
   c. Public sector involvement – 3

4. **Addresses widespread concerns – 4**
   a. Community involvement – 9.4
   b. Public concern – 4.6
   c. Scalable, appropriate and good practices – 3
   d. Cost – 2.2

5. **Capacity (Infrastructure and Human) – 1.1**
   a. Effectiveness – 4.4
   b. Demand-driven – 3.3

6. **Addresses trans-boundary issues – 2**
   a. Addresses policy – 1.2
   b. Addresses management – 2.3
   c. Harmonization – 3.5

7. **Little is known about the issue – 1**
   a. Addresses a key gap – 1.3
   b. Identified by stakeholders – 2.7

S. No 1. Address key society concerns

	Gender	Food Security	Income	Health
Health	Health	Health	Income	
Income	Income	Income		
Food Security	Gender			
Gender				
	1	**0**	**3**	**2**
	5	**2.5**	**10**	**7.5**

S. No 2. Contribute to improving environmental quality

	Pollution Control	Sanitation Improvement	Wetlands Conservation	Biodiversity Conservation
Biodiversity Conservation	Pollution Control	Biodiversity Conservation	Wetlands conservation	
Wetlands Conservation	Pollution Control	Wetlands Conservation		
Sanitation Improvement	Pollution Control			
Pollution Control				
	3	**0**	**2**	**1**
	4	**1**	**3**	**2**
	8.4	**2.2**	**6.2**	**4.2**

S. No 3. Addresses economic development

	Private Sector Involvement	Benefits Communities	Public Sector Involvement
Public Sector Involvement	Private Sector Involvement	Benefits Communities	
Benefits Communities	Benefits Communities		

Private Sector Involvement			
	1	2	0
	2	3	1

S. No 4. Addresses widespread concerns

	Public Concern	Community Involvement
Community Involvement	Community Involvement	Community Involvement
Public Concern	Public Concern	
	1	2
	4.6	9.4

S.No. 5. Scalable, appropriate and good practices

	Cost	Capital (infrastructure & human)	Effectiveness	Demand Driven
Demand Driven	Demand Driven	Demand Driven	Effectiveness	
Effectiveness	Effectiveness	Effectiveness		
Capital	Cost			
Cost				
	1	0	3	2
	2	1	4	3

S. No. 6. Addresses trans-boundary issues

	Addresses Policy	Addresses Management	Harmonization
Harmonization	Harmonization	Harmonization	
Addresses Management	Addresses Management		
Addresses Policy			
	0	1	2
	1	2	3

S. No. 7. Little is known about the issue

	Addresses a Key Gap	Identified by Stakeholder
Identified by Stakeholders	Identified by stakeholders	Identified by Stakeholders
Addresses a Key Gap	Addresses a Key Gap	
	1	2
	1.3	2.7

APPENDIX VII. COMMENTS RECEIVED FROM NATIONAL STAKEHOLDER CONSULTATIVE WORKSHOP HELD AT MUKONO (23RD -25TH JANUARY 2006)

1. Chapter on "Monitoring" should address issues including public health	Public health issues incorporated into the Proposed Monitoring Programme
2. Feasibility study on "Cage Culture" may not be the issue now since USAID is already undertaking pilot cage culture in Lake Victoria. In addition, Lake Harvest, a firm from Zimbabwe, is also undertaking pilot studies	Even if cage culture is being piloted by USAID and Lake Harvest, there is need to undertake additional studies
3. Bukoora River monitoring project be under Water Quality and Quantity Monitoring	Bukoora River catchment monitoring is indeed under "Water Quality and Quantity Project"
4. Cage culture studies should also address issues of fish pathology; this should also factor in issues of the impacts on capture fisheries in the entire lake system	Activity on fish pathology added
5. The issue of sedimentation and siltation and their effects on the lake be addressed	Effects of sedimentation and siltation on the lake incorporated
6. None of the presenters has indicated how information will be disseminated through the media	There is a full consultancy on "Monitoring and Communication" for preparation of LVEMP II
7. What should be the harmonized length of the buffer zone around a water body in the EAC region	On length of buffer zones, a study is on at KARI to determine the length of the buffer strip and the right vegetation that can strip most of the silt
8. Exchange rate of a dollar should be harmonized	Since the Uganda Shilling is so dynamic in relation to a US$, it was advised that the budget be presented in Uganda Shillings.
9. On capture fisheries, there should be aspects of "Appropriate harvesting technologies"	On fisheries harvesting technologies, this will be incorporated in the proposed studies

APPENDIX VIII. BUDGET NOTES FOR THE PROPOSED ARP

This section presents the budgetary notes for the proposed ARP. The budgets are derived from the proposed research activities under each thematic area. In total, nine thematic areas have been budgeted for. An exchange rate of 1 USD for 1,850 UGX is used.

Budgetary notes for the proposed ARP.

Summary of the Budgetary Notes

THEMATIC AREA	THEMATIC AREA	Cost (USD)	Cost (UGX)
1	CAPTURE FISHERIES AND AQUACULTURE	1,848,000	3,418,800,000
2	WATER QUALITY AND QUANTITY	2,302,500	4,259,625,000
3	ATMOSPHERIC DEPOSITION OF NUTRIENTS	512,000	947,200,000
4	CATCHMENTS MANAGEMENT	1,719,000	3,180,150,000
5	AQUATIC WEEDS	460,000	851,000,000
6	SOCIO-ECONOMIC AND PRIVATE SECTOR DEVELOPMEMNT	1,217,000	2,251,450,000
7	BIODIVERSITY OF THE LAKE VICTORIA BASIN	603,000	1,115,550,000
8	MANAGEMENT OF TRANS-BOUNDARY ISSUES	577,000	1,067,450,000
9	DATABASE MANAGEMENT AND PREDICTIVE MODELING	1,181,745	2,186,228,250
	Grand Total	**10,420,245**	**19,277,453,250**
	Balance (out of USD 11,000,000)	**579,755**	**1,072,546,750**

Details of the Budgetary Notes

THEMATIC AREA 1. CAPTURE FISHERIES AND AQUACULTURE

Activity	Description of Activities	Cost (USD)	Cost (UGX)
1.1	**Enhancing fish catches and biodiversity**		

1.1.1	**To devise mechanisms for effective control of use of illegal fishing gears and methods (390,000)**		
	Assess the extent of the use of illegal fishing gears and methods; Assess the impact of different gillnet width on fish stocks		
	Field surveys (per diem, transport, accommodation, reporting)	10,000	18,500,000
	Consultative and sensitization workshops (per diem, transport, accommodation, hall hire, reporting)	60,000	111,000,000
	Explore options for controlling the use of illegal fishing gears and methods		
	Field surveys (per diem, transport, accommodation, reporting)	40,000	74,000,000
	Visits to relevant institutions for on site acquisition of data/information (per diem, transport, accommodation, reporting)	15,000	27,750,000
	Consultative and sensitization workshops (per diem, transport, accommodation, hall hire, reporting)	45,000	83,250,000
	Evaluate the current institutional mechanisms and arrangements and propose ways of strengthening them.		
	Field visits (per diem, transport, accommodation, reporting)	30,000	55,500,000
	Consultative workshops (per diem, transport, accommodation, hall hire, reporting)	40,000	74,000,000
	Develop options for assessing the effectiveness of control mechanisms of illegal gears and methods on fish stock enhancement	60,000	111,000,000
	Establish underlying social and economic factors that prevent adherence to policies, regulations and by-laws. (USD 40,000)		
	Consultative workshops and field visits to develop effective control mechanisms (per diem, transport, accommodation, hall hire, reporting)	40,000	74,000,000

Develop options for assessing the effectiveness of control mechanisms of illegal gears and methods on fish stock enhancement		
Piloting and monitoring of selected control mechanisms (per diem, transport, accommodation, hall hire, reporting)	30,000	
Others		55,500,000
Sub total	20,000	37,000,000
Generate information to inform the protection and enhancement of biodiversity for increased fish production (USD 400,000)	**390,000**	**721,500,000**
To establish critical biodiversity hot spots for protection.		
Field collection of data (per diem, transport, accommodation, reporting)	40,000	
Consultative workshops (per diem, transport, accommodation, hall hire, reporting)	50,000	74,000,000
Use of GIS to map the critical areas (equipment, per diem, transport, accommodation, reporting)	90,000	92,500,000
To assess and monitor the effects of lake level fluctuations on breeding and nursery of fish biodiversity; Explore mechanisms for enhancing fish stocks in the main lake; Develop mechanisms for sustainably managing fish stocks in the lake; Develop options for protecting fish breeding grounds		166,500,000
Field collection of data on water levels (per diem, transport, accommodation, reporting)	60,000	
Collection of data/information on breeding, nursery and feeding grounds (per diem, transport, accommodation, reporting)	40,000	111,000,000
Scaling up (per diem, transport, accommodation, reporting)		74,000,000
Others	100,000	185,000,000
	20,000	37,000,000

Sub total		
Reduction of fish post harvest losses (USD. 140,000)	**400,000**	740,000,000
Developing technologies and practices for reduction of fish post harvest losses among artisan fisher folks		
Establish the extent and underlying causes of post harvest losses	5,000	
Participatory investigation into post harvest losses		9,250,000
Enhance low-cost technologies and capacity to process and preserve fish		
Identify existing low-cost technologies	**5,000**	9,250,000
Participatory investigation into adoption rates of appropriate low-cost technologies	**10,000**	
Explore options for obtaining credit facilities for artisan fisher folks		18,500,000
Multi-stakeholder scaling up of appropriate low-cost technologies	**80,000**	148,000,000
Participatory identification of options for obtaining credit facilities for artisan fisher folks	**5,000**	
Explore mechanisms for developing infrastructure for fish handling, transportation, processing and marketing		9,250,000
Build capacity for using the new technologies		
Improve hygiene and sanitation at the landing sites	**5,000**	9,250,000
Participatory development of improved hygiene and sanitation at the landing sites	**10,000**	
Others		18,500,000
Sub total	**20,000**	37,000,000
	140,000	**259,000,000**
Development of Economically Viable Aquaculture in the Lake Victoria Basin		

To improve aquaculture management practices (US$ 158,000)		
To compile/collect, package and disseminate information on available technologies on pond siting, construction, stocking and management of appropriate fish species for culturing		
collection/compiling information from places	3,000	5,550,000
packaging the information	15,000	27,750,000
stakeholder's workshops (before & after the major activity)	15,000	27,750,000
To explore options for funding to upscale aquaculture		
Exploring options	35,000	64,750,000
Donor/Financiers Conference (before & after)	20,000	37,000,000
Explore and pilot options for funding to upscale aquaculture		
Exploring options	35,000	64,750,000
Donor/Financiers Conference	15,000	27,750,000
Others	20,000	37,000,000
Sub total	**158,000**	**292,300,000**
Increase the production of improved and better quality seeds of different culture species (US$ 220000)		
Evaluate the quality of existing fish seed (US$ 120,000)		
On-farm testing and evaluation of the production of existing seeds	10,000	18,500,000
Experimental tests to evaluate ways the existing seed are being produced	50,000	92,500,000
Stakeholders workshops	15,000	27,750,000
purchase of facilities & equipment, & training of selected farmers & field officers	15,000	27,750,000
Scale up the use of low cost technologies in production of high value and good quality aquaculture fish seed .	80,000	148,000,000
Short- term, 3 to 6 m), and postgraduate (in fish genetics) training	20,000	37,000,000
Develop options for adopting new culture species	10,000	18,500,000

	Others		
	Sub total	20,000	37,000,000
		220,000	407,000,000
1.3.3	**To improve on the quality and cost-effectiveness of fish feeds developed from local and exotic ingredients (US$ 175,000).**		
	Evaluate existing fish feeds and establish quality appropriate for optimum fish growth		
	Visit various farmers in the basin and establish the feeds they use and evaluate them	5,000	9,250,000
	Carry out on-farm tests and establish the quality appropriate for optimum fish growth	20,000	37,000,000
	Develop and pilot fish feeds for the various fish species		
	Carry out pilot studies of fish feeds versus culture species which produce optimally	25,000	46,250,000
	Outside visits and short term training for selected farmers and field officers	35,000	64,750,000
	Postgraduate training (for a fish food nutritionist), purchase of equipment and accessories	25,000	46,250,000
	Promote the use of local ingredients in the production of fish feeds		
	Participatory consumer selection of fish feeds; Participatory piloting of fish feeds	45,000	83,250,000
	Others	20,000	37,000,000
	Subtotal	**175,000**	323,750,000
1.3.4	**To establish the viability of culturing Nile perch (USD 150,000)**		
	Establish the optimum environmental conditions for the Nile perch fry survival and growth	40,000	74,000,000

	Conduct trials to establish optimum conditions for Nile perch survival and growth		
	Identify, formulate and evaluate feeds for optimum growth	70,000	129,500,000
	Establish the optimum marketable size of cultured Nile perch	10,000	18,500,000
	Evaluate the cost-effectiveness and market of cultured Nile perch	10,000	18,500,000
	Others	20,000	37,000,000
	Subtotal	**150,000**	**277,500,000**
1.3.5	**To establish the feasibility of cage culture in the Lake Victoria Basin (USD 215,000)**		
	Establish environmental conditions for cage culture	30,000	55,500,000
	Evaluate the suitability and profitability of different species for cage culture	20,000	37,000,000
	Conduct trials to establish optimum conditions for cage culture; Evaluate the growth of different species under cage culture		
	Identify suitable feeds for cage culture	30,000	55,500,000
	Establish suitability of different sites and cages	15,000	27,750,000
	Establish an environmental monitoring programme	10,000	18,500,000
	Assess the acceptability of cage culture	15,000	27,750,000
	Propose institutional and legal framework for cage culture	20,000	37,000,000
	Identify fish diseases under cage culture and develop preventive measures	55,000	101,750,000
	Others	20,000	37,000,000
	Subtotal	**215,000**	**397,750,000**
	Total	**1,848,000**	**3,418,800,000**

THEMATIC AREA 2. WATER QUALITY AND QUANTITY

Activity	Description of Activities	Amount (USD)	Cost (UGX)
2.1.	**Appropriate Waste and Wastewater Treatment Technologies**		

2.1.1.

To Scale up the Successful Kirinya Waste Treatment Project and Develop Technologies for use in the Collaborative Treatment of Wastes		
Scaling up the Kirinya Tertiary Municipal Effluent Treatment Pilot Project (USD 735,000)		
Evaluate the Kirinya Tertiary Municipal Effluent Treatment Pilot Project in the Murchison Bay and Namiiro wetlands		
Transport costs and accommodation	10,000	18,500,000
Costs for mobilization and meetings with stakeholders as well as identification of appropriate pilot study sites	10,000	18,500,000
Explore options for effective multi-stakeholder waste treatment technologies		
Transport costs and accommodation	10,000	18,500,000
Participatory identification of appropriate technlogies	10,000	18,500,000
Piloting in 2 sites (Nakivubo swamp and Namiro swamp) and technologies for callabotative treatmnet of wastes		
Costs of materials for pilot		
Economic and technical studies on appropriate option (consultancy)	15,000	27,750,000
Design plans	10,000	18,500,000
Labour costs for preparation of study sites	25,000	46,250,000
Ponds rehabilitation	55,000	101,750,000
Equipment e.g. Pipes etc.	150,000	277,500,000
Setting up pilot studies (involving industrialists, re-use, recycling)	150,000	277,500,000
Setting up pilot studies (involving local communities biogas)	150,000	277,500,000
Develop strategies for technology transfer		
Transport and accommodation	30,000	55,500,000
Mobilisation and consultative meetings with stakeholders	20,000	37,000,000
Build capacity to recycle / reuse waste products by key stakeholders		
Training	20,000	37,000,000
Field demonstrations	10,000	18,500,000
Workshops to encourage positive change	20,000	37,000,000

	Others and documentation		
2.2.	**SubTotal**	40,000	74,000,000
2.2.1	**Low-Cost Home-Based Water Treatment Technology and Sanitation Improvement (USD 193,000)**	**735,000**	**1,359,750,000**
	Assess the quantity and quality of water supplied to selected communities		
	Transport and accommodation (5000 x 2)	10,000	18,500,000
	Mobilization and consultative meetings with stakeholders (5000 x 2)	10,000	18,500,000
	Examine and recommend important alternative sources of water to the communities.		
	Transport and accommodation	5,000	9,250,000
	Sanitization seminars	5,000	9,250,000
	Examine the Nsumba model village sanitary and hygienic practices		
	Transport and accommodation	5,000	9,250,000
	Consultative meetings	5,000	9,250,000
	Improve sanitary conditions and reduce waterborne disease prevalence in the selected communities		
	Economic and technical studies on appropriate option (consultancy)	10,000	18,500,000
	Setting up pilot studies (involving local communities/homesteads)	70,000	129,500,000
	Training	10,000	18,500,000
	Workshops to encourage positive change (10000 x 2)	20,000	37,000,000
	Evaluate cheap innovative measures to prevent waterborne diseases though water treatment		
	Consumables (bottles, chemicals)	10,000	18,500,000
	Moringa seedlings/leaves	3,000	5,550,000
	Office Equipment	10,000	18,500,000
	Others	20,000	37,000,000
2.3.	**Subtotal**	**193,000**	**357,050,000**
2.3.1	**Water Quality and Quantity Modelling in Lake Victoria Basin**		

	To complete and operationalize the Lake Victoria Water Quality Model (LVWQM) (USD 261,000)		
	Collect data on catchment		
	Activities		
	Reviewing, testing data		
	Collection of new data	10,000	18,500,000
	Build capacity through training and procurement of equipments	20,000	37,000,000
	Train 4 managers in modelling techniques and application of the WQ model		
	Equipment (hardware and soft ware) High RAM computer	80,000	148,000,000
	In house training through working sessions	67,000	123,950,000
	Use the existing and new data to calibrate	24,000	44,400,000
	Model trials and runs (piloting) - Regional working sessions (2) of model task leaders annually; for 5 years (4000 x 2 x 5 years)		
	Pilot the model to predict trends	40,000	74,000,000
	Calibration of the model (consultancy)		
	Others	10,000	18,500,000
2.3.2.	**Subtotal**	10,000	18,500,000
	Update the Water Balance Model to predict changes in water quantity (675,500)	**261,000**	**482,850,000**
	Establish new and utilize existing networks		
	Establishing networks		
	Evaluate the relationship between ground water fluctuations and lake levels	5,000	9,250,000
	Researchers per diem		
	Transport costs	50,000	92,500,000
	Driver	10,000	18,500,000
	Linking to data / Resource Centre	10,000	18,500,000
	Build capacity through training and procurement of equipments	10,000	18,500,000
	Establishing data collection monitoring networks		
	Siting and installation of piezometers (3 each 13500)		
	Field equipment	40,500	74,925,000
		55,000	101,750,000

	Installation of automatic weather stations (4 each 40000)		
	Installation of river gauging stations (30 each 5000)	150,000	277,500,000
	Linking to data / Resource Centre	150,000	277,500,000
	Collect additional data	10,000	18,500,000
	Collection of data over five years		
	Build capacity	20,000	37,000,000
	Train in modelling techniques and application of the model		
	Use the existing and new data to calibrate	20,000	37,000,000
	Reviewing, testing and calibration of the model		
	Assess the contribution of groundwater to lake pollution	5,000	9,250,000
	Sample analyses (chemisrty)		
	Sample analyses (isotopes)	15,000	27,750,000
	Update and pilot the model to predict trends	50,000	92,500,000
	Model trials and runs (piloting) - 1 Regional 1-week working session annually		
	for 5 years (10000 x 5 years)		
	Analyze trends in the flow quantities	50,000	92,500,000
	Evaluate the current Water Release Policy and propose a new one	5,000	9,250,000
	Others	5,000	9,250,000
2.4	**SubTotal**	20,000	37,000,000
2.4.1.	**Sedimentation in Lake Victoria**	**675,500**	**1,249,675,000**
	To assess rates of sedimentation and siltation on Lake Victoria and to generate a bathymetric map (USD 438,000)		
	Increase the number and operationalize the existing stations		
	Establishing nunber of existing stations		
	Transport, per diem		
	Participatory identification of sites for installation of new pelagic and littoral stations	5,000	9,250,000
	Generate baseline data		
	Transport, per diem, secretarial services	5,000	9,250,000

Increasing stations and establihing new ones		
Technical assistance in setting up study	10,000	18,500,000
Equipment	10,000	18,500,000
Echo sounder		
Sediment traps	10,000	18,500,000
Air-gun	10,000	18,500,000
Sediment corer	10,000	18,500,000
Computer and software	8,000	14,800,000
Determine rates of sedimentation and age of sediments from sediment cores	10,000	18,500,000
Transport costs		
Per diem for researchers	10,000	18,500,000
Analyse samples for nutrients (including biogenic silicon) and organic composition	20,000	37,000,000
Laboratory analysis		
Nutrients and biogenic silicon		
Computer and software	25,000	46,250,000
Determine climatic change from sediment cores and organic remains	25,000	46,250,000
Dating of cores		
Isotopic dating		
Study of organic remains	70,000	129,500,000
Bathymetric mapping	40,000	74,000,000
Hiring of vessel (60 days at 2000)		
Per diem researchers	120,000	222,000,000
Training	10,000	18,500,000
Others	20,000	37,000,000
Sub total	20,000	37,000,000
Grand total	**438,000**	**810,300,000**
	2,302,500	**4,259,625,000**

Activity	THEMATIC AREA 3. ATMOSPHERIC DEPOSITION OF NUTRIENTS Description of Activities	Cost (USD)	Cost (UGX)
3.1.	**Establish the Effects of Atmospheric pollutant depositions on the Lake Ecosystem**		
3.1.1.	**To Update Data on Sources and Quantities of Atmospheric Pollutants Entering Lake Victoria and Come Up with Mitigation Measures to Avert the Associated Problems (USD 512,000)**		
	Assess the contribution of atmospheric pollutants (including nutrient depositions) on Lake Victoria.		
	Reviewing data (desk operation)		
	Collecting data (field activity): (15,000/ year*5 years)	7,000	12,950,000
	Set up a network of monitoring stations across the lake basin on an urban, peri urban, and countryside gradient and on the lake – with less expensive more accurate equipment		
	Setting up and equiping overland monitoring stations (one in each of the following districts: Busia, Jinja, Kampala, Wakiso-Entebbe, Masaka, and Rakai) (20,000*6 stations)	120,000	222,000,000
	Setting up on-lake monitoring stations [one in the eastside, central, and south-side of the lake] (20,000*3 stations)	60,000	111,000,000
	Collect, analyze and monitor atmospheric pollutants in dry and wet depositions		
	Analyzing dry and wet deposition samples (10,000/ year * 5 years)	50,000	92,500,000
	Monitoring atmospheric pollutants deposition (5,000/ year * 5 years)	25,000	46,250,000
	Develop quantitative estimates of atmospheric pollutant deposition loads through monitoring and measurements and identify their sources using isotopic marker methods	30,000	55,500,000

Conduct a comprehensive mass balance study on Lake Victoria to understand the inputs and outputs of contaminants from all sources, including atmospheric deposition			
Collect, analyze and monitor key socio-economic activities that contribute to atmospheric deposition			
Collecting and analyzing key socio-economic activities (5,000/ year * 5 years)	25,000	46,250,000	
Monitoring key socio-economic activities (5,000/ year * 5 years)	25,000	46,250,000	
Determine necessary actions to control and address the impairment caused by atmospheric pollutant depositions			
Adopt cost-effective actions to control and mitigate the impairment caused by atmospheric pollutants.			
Demonstrations	55,000	101,750,000	
Cleanups	50,000	92,500,000	
Capacity building (2 M.sc. student * 6 semester * 2,000)	24,000	44,400,000	
Others	36,000	66,600,000	
Propose trade-off measures so that the international community can be requested to pay compensation for the atmospheric pollution of Lake Victoria if it is established that the pollutants emanate from beyond the Eastern African Region.	5,000	9,250,000	
Total	**512,000**	**947,200,000**	

THEMATIC AREA 4. CATCHMENTS MANAGEMENT

Activity	**Description of Activities**	**Costs (USD)**	**UGX**
	TARGET: 3 districts, 2 sub counties/district (i.e. 6 sub counties)		

	The River Bukora Integrated Watershed Management		
	Result area 4.1 R.Bukora Integrated watershed management		
4.1.1	**Developing and promoting better and sustainable rangeland and forestry management strategies (USD 469,000)**		
	M&E Baseline survey		
	Community mobilisation, sensitisation and action planning	5,000	9,250,000
	Regular supervisory visits (*1 pick up vehicle*)	20,000	37,000,000
	Socio-economic studies to assess the extent, impact and replacement value of selected degraded hotspots in the catchment	70,000	129,500,000
	Participatory Identification of issues & solutions		
	Develop local institutional arrangement and legal frame work for management of rangelands	7,000	12,950,000
	Develop and upscale viable management options for rangelands and forests	7,000	12,950,000
	Carry out participatory land resource assessment and land use planning and popularize use of land use plans by the districts, sub county leaders plus communities (Field & lab equipment, staff training).	40,000	74,000,000
	Participatory evaluation of different water harvesting options for:		
	Livestock watering		
	Effectiveness in soil erosion and runoff control,	30,000	55,500,000
	Construct valley dams and improve on the existing ones so as to minimize movement of animals and reduce overgrazing	30,000	55,500,000
	Promote improved pasture management through controlled grazing by zoning off individual land patches for better pasture and livestock management. This could be through: afforestation of zoned patches and conducting adaptation suitability of different fodder species (trees, grass, legume) to the pilot areas	50,000	92,500,000
		30,000	55,500,000

	Explore alternative livestock feed management options (fresh fodder, hay and silage) for dry season feeding	20,000	37,000,000
	Participatory development and promotion of commercial tree nurseries	20,000	37,000,000
	Participatory development of site specific afforestation options for selected degradation hotspots in different farming systems	50,000	92,500,000
	Explore mechanisms to facilitate involvement of communities in the establishment, management, utilization and conservation so as to achieve sustainable management of forest reserve areas e.g. through co-management	20,000	37,000,000
	Build capacity and systems for multi-stakeholder management of rangeland and forestry resources		
	Training, exchange visits, etc	50,000	92,500,000
	Others	20,000	37,000,000
	Sub total	**469,000**	**867,650,000**
4.1.2	**Promoting improved management strategies for cultivated farmlands of River Bukora catchment USD 280,000)**		
	Identify and upscale economically viable farming practices (building on LVEMP 1 and other pilot studies in the region) e.g. integrated soil fertility and water management, water harvesting, pest management, agro-forestry and crop livestock integration)		
	Participatory review of existing farm practices	10,000	18,500,000
	Community sensitization and action planning (including local, opinion and political leaders) on use of best land management practices.	10,000	18,500,000
	Build capacity of farmers and service providers in support of improved farming practices		
	Carry out participatory land resource assessment and land use planning and popularize use of land use plans by the districts, sub county leaders plus communities	30,000	55,500,000
	Participatory piloting of viable farming practices		

Review and strengthen integrated soil and water conservation using a catchment approach (e.g. soil conservation, terracing, contours and strip cultivation, ridge and tie ridging practices, grass strips and bands), clearly defining the roles of local councils and chiefs with regard to enforcement of conservation measures	45,000	83,250,000
Integrated soil fertility management encompassing the use of organic and inorganic fertilizers plus sustainable organic farming and reduced tillage among others	35,000	64,750,000
Reinforce good agronomic practices such as crop rotation to minimize soil degradation and sustain productivity	10,000	18,500,000
Crop livestock integration including management of farmyard manure	10,000	18,500,000
Sustainable agro-forestry options in different farming systems based on farmer-selected tree species	25,000	46,250,000
Promote small scale irrigation where feasible	25,000	46,250,000
Strengthen local institutions (e.g. local leaders, CBOs, women groups) for monitoring and enhancing adoption of improved farming practices		
Training, exposure, exchange visits and short courses	50,000	92,500,000
Regular reflection and learning sessions with stakeholders	10,000	18,500,000
Others	20,000	37,000,000
Sub total	**280,000**	**518,000,000**
4.1.3 **Restoration of ecosystem functioning of selected wetlands in the River Bukora catchment (USD 320,000)**		
Promotion of community participation in the management and restoration of selected wetlands in the catchment		
Mobilize, sensitize and train of stake holder communities	10,000	18,500,000
Demarcate the selected wetlands	15,000	27,750,000
Mapping the distribution/use of the wetlands of River Bukora catchment and select key sites as pilot restoration schemes	15,000	27,750,000

	Participatory appraisal of community institutions, user groups, their interest and practices;	10,000	18,500,000
	Collection of key ecological and socio-economic baseline data including: (Initial wetland size - (map), Inventory of selected key biodiversity, Dominant vegetation types and cover, Water quantity and sustainability of flows, Water quality including silt loads, Existing governance mechanisms and user rights/conflicts and resolution mechanisms, Prevailing uses and community benefits including revenue, Knowledge, attitude and perception of communities living in the wetlands)	15,000	27,750,000
	Generation of management options for enhancing biodiversity and buffering capacity of the selected wetlands;		
	Developing and piloting community action plans for the selected wetlands sites	20,000	37,000,000
	Develop local institutional arrangement and legal framework for management of the wetlands	15,000	27,750,000
	Developing and piloting multi-stakeholder management options	20,000	37,000,000
	Implement wetland management plans	50,000	92,500,000
	Enhance the buffering capacity of wetlands (e.g. Bio-manipulation) (Field & lab equipment, staff training)	90,000	166,500,000
	Data collection & sample analysis	20,000	37,000,000
	Regular reflection and learning sessions with stakeholders to feed into a participatory biodiversity and buffering capacity monitoring mechanism	20,000	37,000,000
	Others	20,000	37,000,000
	Sub total	**320,000**	**592,000,000**
4.1.4	**Piloting mechanisms for monitoring to assess the effects of improved catchment management on siltation and sedimentation in the River Bukora system (USD 215,000)**		
	Assess the importance of siltation and sedimentation in the Bukora catchment (rivers and lakes)		

	Review existing data on siltation and sedimentation in the catchment	10,000	18,500,000
	Field-based baseline information generation	10,000	18,500,000
	Desk-based data analysis for establishing importance	5,000	9,250,000
	Develop and pilot mechanisms for monitoring siltation and sedimentation of water bodies in the catchment		
	Participatory community based monitoring	20,000	37,000,000
	Network with established technical institutions	25,000	46,250,000
	Select sites linked to main objectives and for monitoring	10,000	18,500,000
	Purchase of field equipment (Sediment core samplers, Field equipment for water quality sampling)	45,000	83,250,000
	Training communities in equipment use & data collection	10,000	18,500,000
	Field data collection	35,000	64,750,000
	Sample analysis	15,000	27,750,000
	Information packaging & dissemination	10,000	18,500,000
	Others	20,000	37,000,000
	Sub total	**215,000**	**397,750,000**
4.2	**The Effects of Inappropriate Handling and Use of Agrochemicals on the Environment and Public Health**		
4.2.1.	**To assess the effects of agrochemicals on the environment and Public Health and propose remedial measures (USD 330,000)**		
	Participatory assessment of the use of agrochemicals		
	Sensitization workshops* 12 districts)	50,000	92,500,000
	Scientific assessment and monitoring of soils, water, sediment, organisms for levels of contamination		
	Assessment experiments (collecting analyzing data)	40,000	74,000,000
	Monitoring	20,000	37,000,000
	Collect scientific and social (including IK) data to map hotspots		
	Collecting analyzing social data	20,000	37,000,000
	Mapping hotspost	10,000	18,500,000

	Collect and update information on approved dealers, gazetteer chemicals, restricted-use chemicals, the banned agrochemicals, etc.		
	Collecting and updating information [field activity] (every six months for 5 years12 districts)	100,000	185,000,000
	Pilot options for mitigating the effects of contamination		
	Demonstrations		
	Capacity building	50,000	92,500,000
	Others	10,000	18,500,000
	Sub total	30,000	55,500,000
4.2.2.	**To generate empirical data on the safe handling and use of agrochemicals for policy formulation and implementation (USD 125,000)**	**330,000**	610,500,000
	Review the existing policies, institutions and practices		
	Reviewing documents (desk operation)		
	Review the existing information on agrochemicals and its accessibility to stakeholders	10,000	18,500,000
	Reviewing documents		
	Capacity building	10,000	18,500,000
	Pilot a multi-sectoral and stakeholder study on appropriate application and management of agrochemicals	12,000	22,200,000
	Conducting study (consultancy)		
	Hold workshops/seminars/talk shows to advocate for research-based policy formulation	10,000	18,500,000
	Conducting workshops with local governments (12 districts)		
	Develop new policy on agrochemicals	30,000	55,500,000
	Talk shows (5 TV programs @ 3,000)	20,000	37,000,000
	Others	15,000	27,750,000
	Sub total	18,000	33,300,000
	TOTAL	**125,000**	**231,250,000**
		1,739,000	**444,000,000**

Activity	THEMATIC AREA 5. AQUATIC WEEDS		
	Description of Activities		
5.1	Sustainable control of water hyacinth and other invasive weeds	Cost (USD)	Cost (UGX)
5.1.1	Curb the proliferation of water hyacinth in River Kagera USD 210,000)		
	Review of control status (per diem, transport, accommodation, logistics)		
	Identify effective regional control options (consultation meetings, Test trials, mechanical harvesting transport and accommodation)	10,000	18,500,000
	Pilot selected control options (Scaling up, transport and accommodation, logistics)	80,000	148,000.000
	Others	100,000	185,000,000
	Sub total	20,000	37,000,000
5.1.2	Control annual resurgence of water hyacinth in Lake Victoria (USD 110,000)	210,000	388,500,000
	Research into factors (e.g. environmental, social, economic) sustaining resurgence of water hyacinth		
	Identify and pilot options for effective control of water hyacinth	30,000	55,500,000
	Others	60,000	111,000,000
	Sub total	20,000	37,000,000
5.1.3	Curb proliferation of key native water plants to weed status (USD 90,000)	110,000	203,500,000
	Establish factors (e.g. environmental, social, economic) driving proliferation of native water plants to weed status		
	Investigate the environmental and socio-economic impacts of proliferation of native water plants	20,000	37,000,000
	Research, enhance and pilot options for native weeds control	30,000	55,500,000
	Others	30,000	55,500,000
	Sub total	10,000	18,500,000
5.2	Effective national early warning mechanism for management of water hyacinth and other invasive water weeds (USD 50,000)	90,000	166,500,000
5.2.1	Developing and piloting early warning mechanisms.		
	Identify parameters necessary for developing early warning mechanisms		
		10,000	18,500,000

Evaluate suitability of existing data and mechanisms for early warning	10,000	18,500,000
Piloting th early warning mechanisms	20,000	37,000,000
Others	10,000	18,500,000
Sub total	**50,000**	**92,500,000**
Total	**460,000**	**851,000,000**

THEMATIC AREA 6. SOCIO-ECONOMIC AND PRIVATE SECTOR DEVELOPMEMNT

Activity	Description of Activities	Cost (USD)	Cost (UGX)
6.1.	**Generating options for boosting environmental health and community development**		
6.1.1.	**To promote community-based environmental sanitation and disease control (USD. 268,000)**		
	Investigate the underlying causes of the high prevalence of the communicable and vector borne diseases		
	Participatory assessment in 3 selected communities	20,000	37,000,000
	Writing up and debriefing	5,000	9,250,000
	Examine and evaluate past community participatory interventions in water quality, quantity, supply and sanitation management		
	Detailed economic assessment of 5 successful interventions	15,000	27,750,000
	Participatory feasibility analysis and prioritization of interventions in 4 communities	20,000	37,000,000
	Support 4 prioritized pilots	40,000	74,000,000
	Evaluate behavioral change interventions to mitigate communicable and vector borne diseases		
	Participatory studies to identify incentives and disincentives for positive change in 6 communities	15,000	27,750,000
	Pilot 4 incentive/disincentive interventions	35,000	64,750,000

	Assess options for establishing monitoring mechanisms for tracking communicable and vector borne diseases among transient populations.		
	Participatory identification of priority activities to monitor	10,000	18,500,000
	Community based M&E system in 4 selected communities	18,000	33,300,000
	Capacity building for the community M&E	19,000	35,150,000
	Develop and pilot the tracking system	8,000	14,800,000
	Provide technical support to the system	8,000	14,800,000
	General documentation and information dissemination	15,000	27,750,000
	Explore the use of traditional medicine in the treatment of communicable and vector borne diseases		
	Document the use of herbal medicine in the treatment of communicable and vector borne diseases	20,000	37,000,000
	Others		
	Subtotal	20,000	37,000,000
6.1.2.	**To promote synergies between sustainable Natural Resources management and community development for poverty alleviation (USD. 353.000)**	**268,000**	**495,800,000**
	Evaluate good practices (environmentally friendly strategies) for household waste management		
	Participatory assessment and prioritization of 6 technologies	11,000	20,350,000
	Environmental impact assessment of prioritized technologies	8,000	14,800,000
	Feasibility assessment of scaling up in 4 communities	8,000	14,800,000
	Support scaling up in 4 pilots	18,000	33,300,000
	Scale up identified appropriate technologies		
	Detailed survey of the proven technologies and users' analysis	9,000	16,650,000
	Community participatory appraisal of incentives and disincentives for wider adoption in 4 communities	9,000	16,650,000
	Support identified pilots in 4 different areas	37,000	68,450,000

Share information with stakeholders	5,000	9,250,000
Research into ways of attracting/ interesting the Private Sector into Natural Resources Research		
Participatory assessment of socio-development issues of interest to private sector	10,000	18,500,000
Identify institutions and target groups and facilitate workshops to identify priority research areas	10,000	18,500,000
Support development of joint research programmes and modalities for continuity	3,000	5,550,000
Provide funds to kick start the process	20,000	37,000,000
Documentation and dissemination to stakeholders	5,000	9,250,000
Assess the profitability of prospective enterprises		
Run multi-stakeholder workshops in 4 prioritized areas	19,000	35,150,000
Participatory field based analysis of profitability and farm-gate to market dynamics and costs	9,000	16,650,000
Support pilots to scale up profitable enterprises	33,000	61,050,000
Capacity building of implementers	9,000	16,650,000
Document and disseminate information	5,000	9,250,000
Explore options for linking natural resources users to markets to increase net returns to households (USD 85,000)		
Participatory identification of products to be promoted	10,000	18,500,000
Market link and potential assessment	10,000	18,500,000
Producer preparation and capacity building	10,000	18,500,000
Support 4 pilot projects	40,000	74,000,000
Documentation and dissemination to stakeholders	5,000	9,250,000
Explore alternative and viable investments for fisher folks; Evaluate the user-friendliness of existing micro-finance services for producer communities,		

	Develop and pilot alternative investments for fisher folks		
	Others	30,000	55,500,000
	Subtotal	20,000	37,000,000
6.2.	**Generating options for enhancing private-public-community partnerships for sustainable natural resources based development (USD 883,000)**	**353,000**	**653,050,000**
6.2.1.	**Boosting NR yields to commercially sustainable levels: Private-community partnerships project for sustaining incomes of producer groups (USD 303,000)**		
	Evaluate past interventions in demand-driven research-extension for purposes of identifying good practices for linking farmers to markets and farm inputs		
	Facilitate cost-benefit analysis of massive production and marketing of 4 technologies prioritized by communities for scaling up	10,000	18,500,000
	Run workshops with private sector, public officers and consumers on the pricing and distribution of technologies, and mechanisms for monitoring demand	30,000	55,500,000
	Provide funds to kick start the scaling up of the marketing technologies		
	Documentation and dissemination to stakeholders	9,000	16,650,000
	Development of strategies for linking private sector with research	5,000	9,250,000
	Identify private, public and community institutions and target groups in three districts and facilitate workshops to identify priority research areas	6,000	11,100,000
	Support development of joint research programmes and modalities for continuity	6,000	11,100,000
	Provide funds to kick start the process		
	Documentation and dissemination to stakeholders	25,000	46,250,000
	Public-private sector assessment of the profitability of prospective enterprises	5,000	9,250,000

Carry out Public-private joint cost-benefit analysis of the above enterprises from 3 districts	9,000	16,650,000
Assess the current capacity to initiate and sustain the enterprises	6,000	11,100,000
Workshops involving Public-private personnel to assess readiness, challenges and opportunities	13,000	24,050,000
Support 3 jointly funded pilots in each district (provide seed money)	42,000	77,700,000
Document and disseminate to stakeholders	5,000	9,250,000
Review existing micro-finance services and propose appropriate mechanisms for producer communities		
Develop a list of the types of micro finance institutions supporting natural resources related initiatives, target group, conditions of service and repayment rates	2,000	3,700,000
Prioritization and field visit to clients of the best 4	8,000	14,800,000
Workshop of clients, staff the micro finance institutions to discuss principles, good practices,	20,000	37,000,000
Support the development and piloting of a mechanism for 4 natural resource based enterprises	35,000	64,750,000
Document and disseminate to stakeholders	5,000	9,250,000
Explore and develop incentives and disincentives for private sector involvement in natural resources development		
Institution based appraisal of incentives and disincentives of private sector institutions	5,000	9,250,000
Desk compilation and analysis	2,000	3,700,000
Workshop to debrief to prioritize issues and develop proposals for enhancing involvement	10,000	18,500,000
Support mitigation of the most pressing for 2 natural resources based enterprises	20,000	37,000,000
Document and disseminate to stakeholders	5,000	9,250,000
Others	20,000	37,000,000

	Subtotal	**303,000**	**560,550,000**
6.2.2.	**Developing and publicize the tourism potential of the basin (multi-stakeholder project) (USD 293,000)**		
	Assess the performance of existing ecotourism projects		
	Evaluate the performance of existing ecotourism projects	10,000	18,500,000
	To identify potential tourist destination for piloting		
	Review information and visit to potential areas	2,000	3,700,000
	Internet survey on tourist attractions and identify possible targets	2,000	3,700,000
	Feasibility analysis of 4 natural prioritized projects	10,000	18,500,000
	Workshop with private sector, community groups and officers from line ministries to develop pilot projects	17,000	31,450,000
	Provide support to pilots	45,000	83,250,000
	Document and disseminate to stakeholders	5,000	9,250,000
	Support documentation and publications on key sites		
	Participatory identification of natural resources and community activities to include in the project.	10,000	18,500,000
	Hire publishers to make documentaries to promote the sites	17,000	31,450,000
	Set up systems to monitor numbers and kinds of tourists	4,000	7,400,000
	Develop and support publication of tourist loop joining several sites in the catchment	18,000	33,300,000
	Up date publications annually for the first four years to interest more tourists	9,000	16,650,000
	Capacity building	9,000	16,650,000
	Monitor progress at the sites	7,000	12,950,000
	Support the development of modalities for community participation in the management and sharing of benefit with private sector agencies		
	Run workshops for private sector and communities to develop management modalities	20,000	37,000,000

Facilitate community visioning to determine changes that need to happen to boost tourism	20,000	37,000,000
Develop modalities for sharing profits and what community profits will be used for (towards the vision)	8,000	14,800,000
Monitor benefit sharing and community development	4,000	7,400,000
Document and disseminate to stakeholders	5,000	9,250,000
Develop mechanisms for joint development of sites by interested stakeholders through pilot studies		
Participatory development of cost sharing mechanism (costs from earlier work)	8,000	14,800,000
Capacity building	10,000	18,500,000
Support to implementation and monitoring	20,000	37,000,000
Reflection meetings for fine-tuning	8,000	14,800,000
Documentation and dissemination to stakeholders	5,000	9,250,000
Others	20,000	37,000,000
Subtotal	**293,000**	**542,050,000**
TOTAL	**1,217,000**	**2,251,450,000**

THEMATIC AREA 7. BIODIVERSITY OF THE LAKE VICTORIA BASIN

Activity	Description of Activities	Cost (USD)	Cost (UGX)
	7.1.1. To generate information on the status and processes of aquatic biodiversity changes (USD 200,000)		
	Inventory the status of aquatic biodiversity (eg fish species, mammals, herpetiles) in both L.Victoria and satellite lakes of the basin	45,000	
	Complete Biodiversity Atlas	45,000	83,250,000
	Research into underlyig causes for changes in biodiversity	45,000	83,250,000
	Reasearch into the role of the microbial loop on biodiversity	45,000	83,250,000

	Others		
	Sub total	20,000	37,000,000
7.1.2.	**To restore sustainable populations of large mammalian herbivores and carnivores in the lake's catchment (USD 95,000)**	**200,000**	**370,000,000**
	Scale up Lake Mburo NP Game cropping project		
	Identify good communtiy based wildlife practices through workshops/seminars	25,000	46,250,000
	Pilot the good practices identified in partnership with private sector	45,000	83,250,000
	Develop participatory action plans for threatened species of wildlife (3 SAPs)	15,000	27,750,000
	Others	10,000	
	Sub total	**95,000**	**175,750,000**
7.1.3.	**Promote community-public-private sector management and conservation of wetland biodiversity (USD 232,000)**		
	Complete biodiversity inventory of critical wetlands (Ramsar sites)		
	Conduct inventories	60,000	111,000,000
	Mapping	20,000	37,000,000
	Enhance the implementation of wetlands management plans for critical areas		
	Sensitization workshops and seminars	15,000	27,750,000
	Pilot the implemetation of community-based action plans	20,000	37,000,000
	Enhance community-based interventions for the conservation of wildlife in selected wetlands		
	Develop community-based interventions	22,000	40,700,000
	Pilot the community-based interventions developed in partnership with private sector	35,000	64,750,000
	Promote community-based wetlands management options (e.g. eco-tourism)		
	Participatory Identificationof options for community based wetland management	12,000	22,200,000
	Pilot community-based option developed in partnership with private sector	28,000	51,800,000
	Others	20,000	37,000,000
	Sub total	**232,000**	429,200,000

7.1.4	**Review current policies and practices to inform the restoration in degraded rangelands (76,000)**		
	Desk review	2,000	3,700,000
	Sensitization workshops and seminars	12,000	22,200,000
	Research into options for halting rangeland biodiversity loss	35,000	64,750,000
	Pilot the good practices and policies for halting rangeland biodiversity loss	17,000	31,450,000
	Others	10,000	18,500,000
	Sub total	**76,000**	140,600,000
	Total	**603,000**	**1,115,550,000**

THEMATIC AREA 8. MANAGEMENT OF TRANS-BOUNDARY ISSUES

Activity	Description of Activities	Cost (USD)	Cost (UGX
8.1.	**Promoting collaborative natural resources management and harmonisation of key cross border policies.**		
8.1.1.	**Generate options for conflict management across borders (USD 102,000)**		
	Investigate underlying causes of conflicts (e.g. theft of fishing gears, piracy)		
	Review existing data on causes of conflicts	2,000	3,700,000
	Participatory investigation of the underlying causes of conflicts	45,000	83,250,000
	Develop and pilot conflict management options for key conflict areas	45,000	83,250,000
	Others		
	Sub total	10,000	18,500,000
		102,000	**188,700,000**
8.1.2.	**Developing strategic management options for controlling crop pests and livestock diseases (USD 100,000)**		

	Conduct detailed survey to identify key trans-boundary management issues of major livestock diseases and crop pests		
	Participatory identification and analysis of key trans-boundary management issues	45,000	83,250,000
	Develop and pilot participatory strategies for the control of livestock diseases and crop pests	45,000	83,250,000
	Others		
	Sub total	10,000	18,500,000
8.1.3.	**Develop and promote mechanisms for regulating and coordinating Trans-boundary trade and commerce (142,000)**	**100,000**	**185,000,000**
	Review existing policies and regulations on Trans-boundary trade and commerce		
	Desk review of the existing policies/regulations to identify key areas for revision	2,000	3,700,000
	Identify and propose areas for revision in the policies, standards and regulations for cross-border trade and commerce		
	Participatory review and revision of key policies, standards and regulations	50,000	92,500,000
	Database development for recording origin, quantities and destinations of natural resources products	60,000	111,000,000
	Develop and pilot mechanisms for formalizing and regulating cross-border trade and commerce		
	Pilot mechanisms for cross-border trade and commerce policy implementation	20,000	37,000,000
	Others		
	Sub total	10,000	
8.2.	**Promote Effective Environmental Governance through Institutional Collaboration and Harmonization of Laws and Policies**	**142,000**	**262,700,000**

8.2.1.	**Generate Strategies for Effective Trans-boundary Environmental Governance**		
	Investigate the underlying causes of ineffective enforcement of environmental laws and policies		
	Examine the existing laws, policies and institutional framework for environmental governance and identify causes of lack of effective implementation of laws and policies; Field studies (per diem, transport, accommodation, reporting)	10,000	18,500,000
	Consultative and sensitization workshops (per diem, transport, accommodation, hall hire, reporting)	20,000	37,000,000
	Participatory piloting of mechanisms for environmental governance using existing laws, policies and institutional frameworks	50,000	92,500,000
	Propose strategies for harmonization of trans-boundary environmental laws; Propose options for intervention to ensure effective environmental governance		
	Field collection of data (per diem, transport, accommodation, reporting)	20,000	37,000,000
	Piloting participatory multi-stakeholder options for interventions to ensure effective environmental governance	50,000	92,500,000
	Identification of sites for project implementation		
	Others	50,000	92,500,000
	Sub total	33,000	61,050,000
	Total	**233,000**	**431,050,000**
		577,000	**1,067,450,000**

THEMATIC AREA 9: DATABASE MANAGEMENT AND PREDICTIVE MODELING

Activity	Description of Activities	Amount (USD)	Cost (UGX)
9.1.	**Improved data collection, processing, storage and management**		

.1.1	**To standardize methods for data collection and handling to facilitate networking among key stakeholders**		
	Conduct workshops/meetings for prioritising the selection of variables for measurement: Per diem for 25 participants for 4 days at US $ 300 per day	25,000	46,250,000
	Prepare data collection forms: 11 person days at US $ 150 per day	1,650	3,052,500
	Pre-test the data collection forms:		
	Conduct preliminary data collection for each thematic area: Per diem for 16 investigators and 3 drivers at US $ 42 per day for 5 days	3,360	6,216,000
	Modify the data collection forms where applicable: 10 person days at US $ at 150 per day	1,500	2,775,000
	Others		
	Sub total	5,000	9,250,000
.1.2.	**Building capacity for creation and use of GIS database for networking**	**36,510**	**67,543,500**
	Conduct GIS training workshop for investigators:		
	Basic course in GIS technology		
	Accommodation for 45 participants at US $ 75 per participant for 14 days	47,250	87,412,500
	Meals for 45 participants at US $ 25 per participant for 14 days for 3 groups	15,750	29,137,500
	3 resources persons for 45 days at US $ 150 per day per resource person)	20,250	37,462,500
	Hire of GIS training facilities for 45 participants for 14 days at US $ 480 per day for 14 days for 3 groups)	20,160	37,296,000
	Transport refund for 45 participants at US $ 70 per participant for 3 sub regions	3,150	5,827,500
	Stationery for course materials for 45 participants at US $ 15 per participant	675	1,248,750
	Establish a GIS database from data collected by each theme (1-8) and by any other component of LVEMP II		

Assemblage of high capacity computer hard/software for database management and capacity modeling		
3 GIS workstations installed with ArcGIS and statistical packages	440,000	814,000,000
Customization of a database (e.g. MS Access/Fox Pro): 75,000 (375 person days at US $ 200 per day) - consultancy	75,000	138,750,000
Data entry into the customized database: 2 data entry clerks at US $ 21,600 per year for 4 years	43,200	79,920,000
Preparation of metadata ('data on data'): 66 person days at US $ 200 per day	13,200	24,420,000
Database maintenance and updating: Database manager for 48 calendar months at US $ 1,000 per month	48,000	88,800,000
Modeling different scenarios using the created database:		
Scenario formulation and validation; running models for different scenarios and validation of scenario results: 528 person days at US $ 150 per day for the modeling group (in 1 mathematician, 1 statistician)	79,200	146,520,000
Package information for different stakeholders		
Prepare policy briefs, brochures, posters, articles for print media, radio\TV casting	50,000	92,500,000
Communicate the packaged information		
Conduct meetings with policy makers, private sector, communities, radio/TV talk shows, public radio announcements	90,000	166,500,000
Operationalise systems developed		
Others	169,400	
Sub Total	30,000	
Total	**1,145,235**	**2,118,684,750**
	1,181,745	**2,186,228,250**

APPENDIX IX. KEY DOCUMENTS STUDIED

The following documents were studied for the purposes of identifying key gaps and information on other ongoing programmes/projects that have a bearing on the proposed ARP

S/No.	Document	Relevance to the ARP	Remarks
1	Strategic Action Plan (Draft SAP Report, 2006)	-Identifies thematic areas, key trans-boundary issues,	-The RTDA did not identify the thematic areas but the SAP does so -Presents 18 key trans-boundary issues from which applied research activities can be identified
2	NTDA (2006)	-Identification of priority trans-boundary issues and their diagnosis -In-depth understanding of LVB and existing environmental characteristics especially levels of degradation -Identification of institutional and stakeholder participation areas -Suggesting options to address key issues and interventions by ARP -Outlining the actions to be implemented by each country to address priority areas identified -Identifying progress indicators and milestones where achievements can be measured -Identification of country-driven investments in preventing further degradation of LVB	-Useful quantitative data in formulating monitoring and evaluation mechanisms to ensure effective implementation of the programs in applied research -NTDA and RTDA documents will help to identify on priority issues and investments to remedy the environmental degradation -In general, the information will be useful in filling in data gaps identified in RTDA document and refining regional priority areas

		-Identifying present and future demands for ecosystem services -Designing a program for natural resource conflict management at national and regional levels -Designing training programs for ARP	
3	RTDA (draft)	-Did not identify thematic areas for intervention -Formulation of mitigation measures for proposed activities	-The regional priorities are not yet conclusive in the Final Draft RTDA document -It defined the trans-boundary problems, causes and mitigation measures -The LVB Vision and Strategic Framework Report and consultative workshops will help to refine the regional priority areas
4	Lessons Learnt Reports, LVEMP1	-Identification of successful activities that need scaling up -Identification of areas that need capacity building -Gaps identification	-The information will be useful in filling gaps in applied research
5	State of Fisheries Resources of Lake Victoria and their Management (EAC, LVFO 2005)	-Conference proceedings providing improved understanding of the current situation and actions that should be undertaken towards sustainable development and management of the fisheries resources	-The document gives an opportunity to review the past and on-going research areas in the basin.
6	National Draft Final Report on the Management Framework for Monitoring and Communication	-Relates lake basin monitoring and communication to national development goals and action plans -Brings to the forefront the importance of involvement of all stakeholders in monitoring and evaluation	-The draft report though not complete provides a framework for identifying indicators to be monitored during the applied research implementation -The component is vital for applied research

	for the Lake Victoria Basin in Uganda (LVEMP II Preparation, 2006)	-Provides lake-wide monitoring framework -Provides a framework for communication and management information systems	data management since the ARP will generated a lot of data and information -will disseminate applied research findings and link them to development
7	Provisional Fisheries Sector Strategic Plan (GoU)	-Targets eradication of poverty in fisheries communities and the maximization of the contribution of the sector to national economic growth -Underscores the 10-year sustainable management and development of capture fisheries and aquaculture for the benefit of the present and the future generations	-Helps to link the ARP to the national plans for the development of the sector
8	The Vision and Strategy Framework for Management and Development of LVB (2003)	-Complementing in identification of thematic areas for intervention -Complementing in outlining the actions to be implemented by each country to address priority issues -Identification of national and regionally driven reforms and investments -Establishing LVB status, trends and identification of progress indicators and setting clear milestones where achievements can be measured -Developing strategic action program for the protection of threatened natural resources and ecosystem within the LVB	-The data provided is however limited to Tanzania, Kenya and Uganda. NTDAs and the scheduled consultative workshops will supplement the information on Rwanda and Burundi profiles -The NTDAs and RTDA and subsequently country consultative workshops will be useful in validating and building consensus on the preliminary priorities at the regional level.
9	Protocol for sustainable Development of LVB (2004)	-Contextual setting and describing the multi-country commitments made and formulating institutions arrangements needed for ensuring the implementation of the programs and for monitoring its effectiveness	-Multi-country commitments will be solicited in s consultative manner
10	Dropping water	-Provides quick reference to provide basic water resources	-Highlights of the causes of lake level drop

	levels of Lake Victoria (WRMD, 2005)	information on the hydrology of Lake Victoria in regard to the falling lake levels	and policy implications -Gaps to be addressed by applied research identified
11	The East African Community Development Strategy (2001-2005) (2001)	-Ensuring the proposed measures by ARP conform to regional policies -Describes the multi-country commitments made -Formulating appropriate institutional arrangements needed for ensuring the implementation of the ARP	More country commitments to ARP will be solicited from stakeholders' consultative workshops
12	National Economic Development: Natural Resources Interventions / Investments Component (Draft Final Report, LVEMP II Preparation, 2006)	-Identifies short and long term priority investments in the basin -It also proposes the establishment of an investment fund to support sustainable investment at national and trans-boundary levels with emphasis on micro-enterprises	-Report not completed but highlights areas of applied research that need to be addressed by ARP
13	National Economic Development: Private sector Development Component (Mid Term Report, LVEMP II Preparation, 2006	-Highlights priority areas for private sector investment -Highlights successful rural productivity and growth enhancing pilot works undertaken during LVEMP1	-Complements on the other LVEMP2 preparation draft reports underscoring applied research areas. -Not yet complete and hence bound to change
14	Dialogue on the	Identifying thematic areas for intervention based on	To be validated by consultative workshops

	Regional Integration in East Africa (2001)	expectations on economic integration	
15	Water Resources and Environment-World Bank Technical Notes (2003)	Adding knowledge on current scientific and technical principles for integrated watershed management applicable to LVB	To be understood in the context to the EAC Region
16	Mitigation of Environmental Problems in Lake Victoria, East Africa: Causal Chain and Policy Options Analysis (2004)	-Highlights possible policy options that can help in the protection of threatened natural resources and ecosystems within LVB	-From Royal Swedish Academy of Science, 2004 and ought to be understood on the context to the EAC for guiding applied research.
17	One Basin at a time: The GEF and Governance of Trans-boundary Waters (2004)	Describing the multi-country institutional arrangements needed for applied research agenda Enhancing the contractual environment and regional governance institutions	Sourced from Global Environmental Politics, 2004 and ought to be understood on the context to the EAC Region
18	Global International Waters Assessment (GIWA), East African Rift Valley Lakes, GIWA Regional Assessment 47 (2004)	-Similarities in regional Lakes environmental characteristics especially on contents, thematic areas and trans-boundary issues Shared methodological issues Shared policy options especially describing institutional arrangements	By UNEP, GEF and KALMAR (2004)
19	Strategy for preparation of	-Identification of thematic areas	East African Community (May 2004)

	Lake Victoria Environmental Management Project Phase Two (LVEMP-2) 2004	Options for Institutional Management and Implementation Arrangements	
20	Lake Victoria Environmental Management Project, Phase Two (LVEMP-2), Stakeholder Consultation and Design Workshop (2005)	Formulation of progress indicators that will track whether implementation of the reforms and investments incorporate clear milestones where achievements can be measured	By the EAC Secretariat and Report prepared
21	Lake Victoria Environmental Management Project, Phase Two (LVEMP-2), Project Inception Note (Chengula, 2006)	-Identification of key trans-boundary issues and thematic areas -Indicative budget for projects to be proposed -Key financing for projects to be proposed	WB views on LVEMP2 programs
22	National Water Quality Synthesis Report LVEMP1 (2005)	-National summary of all the LVEMP1 activities in water quality and quantity highlighting achievements and gaps that need to be addressed -Reviews the capacity developed under LVEMP to manage water quality and quantity	-Applied research areas identified for LVEMP2 -Provides an opportunity for lessons learned in the design of applied research for LVEMP2
23	Regional water Quality Synthesis Report LVEMP1 (2005)	-Regional summary of all the LVEMP1 activities in water quality and quantity -Reviews the capacity developed under LVEMP to	-Provides an opportunity for lessons learned in the design of applied research for LVEMP2

		manage water quality and quantity	
24	Sio, Malaba-Malakisi River Basin Integrated Water Resources Management Project (2003).	-Identification of gaps that have not been addressed by LVEMP I and NBI -Complementary to LVEMP II	-Applied research areas identified for LVEMP2 -helps to avoid duplication
25	Mara River Basin Integrated Water Resource Management Project (2003).	-Identification of gaps that have not been addressed by LVEMP I and NBI -Complementary to LVEMP II	-Applied research areas identified for LVEMP2 -helps to avoid duplication
26	Kagera River Basin Integrated Water Resources Management Project (2003).	-Identification of gaps in transboundary issues -Complementary to LVEMP II	-Applied research areas identified for LVEMP2 -helps to avoid duplication